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ICAR

# A HISTORY OF THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

M. S. RANDHAWA

A HISTORY OF

# THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

## 1929-1979

M. S. RANDHAWA
D. Sc., I. C. S. (Retired)
*Fellow of the Indian National Science Academy*

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# PREFACE

THE Indian Council of Agricultural Research will be 50 years of age in August 1979. It was set up in 1929 on the recommendation of the Royal Commission on Agriculture. The birth of ICAR is not a sudden development. It is culmination of a process which started in 1869, when Lord Mayo became Governor-General of India. During the Viceroyalty of Lord Curzon from 1898 to 1905, agricultural research and education received recognition. The Imperial Agricultural Research Institute at Pusa in Bihar was set up in 1905, and Departments of Agriculture were established in the Provinces.

Since Independence remarkable work has been done in the expansion of ICAR and other organizations concerned with agricultural research. An outstanding achievement is attainment of self-sufficiency in food by the country. This is in spite of the fact that India's population rose from 200 million in 1929 to more than 600 million in 1979. Most of the increases in production of cereals have taken place from 1965 onwards. These increases are largely due to the introduction of high-yielding varieties of wheat, rice, pearlmillet (*bajra*) and maize and their adaption to Indian conditions. Our scientists were not the mere recipients of this material but they improved it significantly. They also worked out packages of practices including agronomic and plant-protection measures in respect of these crops. The newly started agricultural universities forged a linkage between the scientists and the farmers. The new varieties found ready acceptance by the farmers, who adopted tractor cultivation, tube-well irrigation and the use of chemical fertilizers and plant-protection chemicals. Owing to the acceptance of modern technology by the farmers, production of food-grains increased remarkably. It almost trebled within 12 years, taking 1965-66 as the base. Increase in the production of wheat was most spectacular.

| Crop | 1965-1966 millions tonnes | 1977-1978 million tonnes |
|---|---|---|
| Wheat | 10.39 | 31.32 |
| Rice | 30.59 | 52.67 |
| Total food-grains | 72.34 | 125.60 |

With such an achievement to its credit, which is unparallelled in the history of agriculture in India, it is befitting that the ICAR should

celebrate its Golden Jubilee with a sense of achivement. This will also enable us to take stock of the progress made and to examine the problems which are to be tackled in future.

The Golden Jubilee Committee of the ICAR decided at its meeting held on 5 August 1978 that *A History of the ICAR* should be prepared on the occasion of its celebration in 1979. So far we have not paid any attention to the history of agriculture in this country. No attempt has been made in identifying the contributions of individuals in the process of development of agricultural research. In this process, both the scientists and the administrators have made their contributions but their work remains to be recognized. The names of those who worked to create the ICAR lie buried deep in the files. Anonymity may suit government organizations, but for science we must make an attempt to identify the role of individuals. No doubt, it is some exceptional men of talent with strong interest in some aspects of agricultural sciences and agricultural development who have made the ICAR what it is now. Having been associated with the ICAR in various capacities since 1945, I was entrusted with the responsibility of presenting a short history of the ICAR and its research organizations. I had the good fortune of knowing personally most of the persons who have been Presidents, Vice-Presidents, Secretaries, Agricultural and Animal Husbandry Commissioners of the ICAR as well as leading agricultural scientists.

When I joined the ICAR as its Secretary in 1945, Sir Jogendra Singh, member of the Viceroy's Executive Council in charge of the Department of Education, Health and Lands, was the President of the ICAR. He was a farmer with deep interest in agricultural development. He was one of the pioneers in tractor cultivation at a time when tractors were powered by steam and were scarce. Sir Herbert Ray Stewart, who had served as Director of Agriculture in the Punjab, was the Vice-President. A stern and serious man, Stewart had specialized in farm accounts and knew the role of statistics in measuring the growth of agriculture. He was a hard task-master and himself spared no pains and expected others also to put in their best effort. His predecessor was Sir Bryce Burt, who did a great deal of work to build up the infrastructure for the scientific functioning of the Council. Dr. P. V. Sukhatme was the Statistical Adviser and had evolved the technique of crop-cutting experiments for estimating crop yields. Major Graham Williamson, a renowned veterinary scientist, was the Animal Husbandry Commissioner.

I also used to meet Sir Pheroze Kharegat, Secretary of the Depart-

ment of Agriculture, who had worked as Vice-President of the ICAR from 1939 to 1944. A lean and thin man with an ascetic face, Sir Pheroze took keen interest in agriculture. His *Memorandum on the Development of Agriculture and Animal Husbandry in India* is a model of lucidity and brevity in expression.

At that time the office of the ICAR was located in the dingy and untidy hutments close to the Connaught Circus. They were a legacy of the Second World War and were no longer required by the Army. The Vice-President, the Secretary and the Agricultural and Animal Husbandry Commissioners were provided office accommodation in the east wing of the North Block. I was given a small room with wooden partitions in the North Block. After having enjoyed outdoor life as the Deputy Commissioner of Rae Bareily for five years, I felt cooped up in that small room. One had to be content with whatever accommodation was given, for on an occasion I was sharply reminded by a Joint Secretary of the Department of Education, Health and Lands that the ICAR was merely an attached office of the Ministry. Later on, as more accommodation was released by the South East Asia Command, who were winding up, we moved to the western wing of the North Block where more respectable rooms were provided.

In October 1945 I was made Secretary of the Indian delegation to the second FAO conference which was held at Quebec in Canada. The Second World War had just ended and the delegation travelled from Delhi to Karachi in a ramshackle Dakota. Thence onward we travelled in Liberator bomber planes converted to civilian use. One of the members of our delegation was Dewan Sir T. Vijaya Raghavacharya, who was the first Vice-President of the ICAR. A short-statured old man with a handsome face, he was a picturesque figure. His gold-braided Mysore turban made him conspicuous. He had sense of humour and a fund of stories and kept us amused and happy during the journey. He entrusted me with a small tin containing curry powder. This was his constant companion in his travels. When we reached Quebec we registered ourselves at the Hotel Chateau Fontenac, the venue of the Conference. The Conference staff found it difficult to pronounce the name of Sir T. Vijaya Raghavacharya and they used to call him 'gentleman with the impossible name'. Sir T. Vijaya Raghavacharya gallantly came to their rescue and advised them to call him 'Dear One'. The leader of the Indian delegation was Sir Girja Shankar Bajpai, Agent-General of the Government of India in Washington. He was one of the founders of the ICAR and was also its President from 1940 to 1941. By his elo-

quence and ability he commanded respect of the delegates to the Conference.

India was then on the eve of Independence. The meeting of the Governing Body of the ICAR held in March 1946 was a landmark. At that meeting, which was presided over by Sir Jogendra Singh, the name of the Council was changed from 'Imperial' to 'Indian'. This change was smooth and did not cause much administrative inconvenience, as it still remained ICAR.

In 1946 the Congress Party joined the Interim Government. Sir Jogendra Singh resigned and Babu Rajendra Prasad became the Minister for Food and Agriculture and President of the ICAR. He remained in that capacity for about a year but left an impress of his personality on the staff. Modest, unassuming and courteous, he was liked by all.

Sir Herbert Stewart left for England in the same year and Sir Datar Singh, a gentleman farmer from the Montgomery District in the Punjab, succeeded him as Vice-President. Sir Datar Singh had interest in Animal Husbandry and promoted schemes for improvement of indigenous breeds of India, and of *Gao Sadans* for the care of old and incapacitated cattle. Sir Datar Singh is remembered as much for his lavish hospitality as for his practical knowledge of animal husbandry. I left the ICAR in November 1946 to take care of the law-and-order problems of the City of Delhi as its first Indian Deputy Commissioner.

From 1947 to 1950 Shri Jairamdas Daulatram was Minister for Food and Agriculture. The Government of India was confronted with the problems of Partition of India, particularly rehabilitation of the refugees. As such, nothing of significance, so far as the development of agricultural research is concerned, can be attributed to that period.

In 1950, Mr K.M. Munshi, a scholar, author and thinker, succeeded Mr Jairamdas Daulatram. He gave great impetus to farm forestry and promoted the celebration of Tree-Planting Weeks, to which he gave the romantic name of *Van Mahotsava*. Mr Munshi took great interest in the working of the ICAR and the IARI. In 1952 he was succeeded by Mr Rafi Ahmed Kidwai, who handled the problems of food energetically. He is still admired for his administrative ability and unorthodox approach to complex problems.

In 1954 Mr Ajit Prasad Jain, who had done remarkable work in rehabilitating the refugees from West Pakistan, became Minister for Food and Agriculture. Mr K. R. Damle was the Vice-President of the ICAR from 1949 to 1955. I had known him from 1934 when I joined my first appointment in the ICS, as Assistant Magistrate at Saharanpur.

Gentle and pleasant with a smile on his face, he won the friendship and regard of all who came in contact with him. He headed the First Indo-American Team which made far-reaching recommendations for the reorganization of agricultural research. Mr P. N. Thapar, an able administrator, endowed with creative imagination, who had done outstanding work as the Financial Commissioner (Rehabilitation), Punjab, in rehabilitating the refugees from West Pakistan and in guiding the Chandigarh Capital Project, became the Secretary of the Department of Food and Agriculture in 1954. Both Mr Ajit Prasad Jain and Mr P. N. Thapar were familiar with my work in the field of agriculture and community development in Punjab.

In 1955, when Mr K. R. Damle left for another assignment, I was appointed Vice-President of the ICAR. Having faced difficulties in the matter of accommodation when I was the Secretary of the ICAR, my first concern was to pay to the CPWD the price of the recently built block in which ICAR is now located and to fix a label on the building proclaiming its ownership by the ICAR. I also took interest in the construction of the building to house the Institute of Agricultural Research Statistics. In this work Dr V. G. Panse, the Director of the Institute, was of immense help. Mr Ajit Prasad Jain and Dr Punjab Rao Deshmukh, Minister for Agriculture, took great interest in the work of the ICAR. During this period I made an ambitious programme of publishing books and monographs on Agriculture, Horticulture, Algae, Fungi and related subjects.

I also headed the Second Indo-American Team. Here I must pay a tribute to Dr Frank W. Parker, USAID Adviser to the Ministry of Food and Agriculture from 1953 to 1959. He not only promoted the use of fertilizers in India but also took great interest in the scheme of agricultural universities. It was Parker who influenced the Rockefeller Foundation to take interest in agricultural development schemes in India. In 1956 an agreement was reached between the Ministry of Food and Agriculture of the Government of India and the Rockefeller Foundation, which contained two principal features: (i) The Foundation was to assist in the development of the postgraduate school of agriculture at the Indian Agricultural Research Institute (IARI); and (ii) the Foundation was to assist in the development of national research programmes on the improvement of some cereal crops (maize, sorghum and millets initially). Thus the Rockefeller Foundation took on the implementation of some of the First Joint Team's recommendations at the national level. Dr Parker is a real friend of India, with a passionate

concern for its people and their agriculture. His contributions to the development of Indian Agriculture will always be mentioned with respect.

A scheme for Postgraduate School at the Indian Agricultural Research Institute was formulated by Dr Ralph W. Cummings, who had arrived in India in March 1957, to direct the Rockfeller Foundation's programme. Dr Albert Moseman, who had been a member of the First Joint Team and was then Director of Agricultural Programmes for the Rockefeller Foundation in New York, also gave support to the project. In implementing the scheme I received unstinted co-operation from Dr B. P. Pal, Director of the Institute, and from Dr. C. D. Deshmukh, Chairman of the University Grants Commission

I must also mention the outstanding work done by Mr J. V. A. Nehemiah, Secretary of the ICAR, a highly intelligent man, who processed the scheme of agricultural universities. He also promoted the production of farm bulletins.

Mr S. K. Patil was the President of the ICAR from 1959 to 1963. I left the ICAR in1960 to join the Planning Commission as Adviser (Natural Resources), where again I carried on studies on the crops of India. All these studies pointed to the need for more chemical fertilizers, which the country must manufacture or import if it was to achieve self-sufficiency in food.

In 1963 Sardar Swaran Singh succeeded Mr S. K. Patil as Minister of Food and Agriculture and remained in that capacity till 1964. During that period India was facing a grave food crisis and I came back to the Ministry of Agriculture as the Director-General of Intensive Agricultural Areas. It was this work that laid the foundation of the administrative structure which ushered in the Green Revolution.

Between 1962 and 1965 there were three Vice-Presidents of the ICAR, viz. Mr Vidya Shankar, Mr G. R. Kamat and Mr A. D. Pandit. All these three persons are outstanding members of the ICS who served the country with distinction. They did not stay long enough in the ICAR, and after short spells they left for more important assignments.

In 1964 Mr C. Subramaniam became the Minister for Food and Agriculture, Community Development, and President of the ICAR, and continued as such till 1967. The credit for getting accepted by the Government of India the policy of incentive price for foodgrains to the farmers goes to him. In fact it was this decision that promoted the Green Revolution. New technology—which includes the use of improved seed, machinery, chemical fertilizers and plant protection mea-

sures—is costly. It was adopted by the farmers, for they had the assurance that their produce would be purchased by the Government at a remunerative price, which would fully cover their costs and they would also make some profit.

Mr Subramaniam gave dynamic leadership to the ICAR. He ordered the reorganization of the ICAR. Some of the research stations were with the Ministry of Food and Agriculture of the Government of India, and some with the Commodity Committees and the ICAR. Towards the end of 1963, a Committee, known as Agricultural Research Review Team with Dr Marion W. Parker as Chairman, was set up. This Committee recommended centralization of all research under the ICAR. The Commodity Committees were wound up. All research stations and institutes on agriculture, animal husbandry and fisheries came under the jurisdiction of the ICAR. Thus problems of agricultural research instead of being fragmented could be viewed in their totality.

In 1965 Dr B. P. Pal, an outstanding plant breeder, who was the Director of the Indian Agricultural Research Institute, joined the ICAR as its Vice-President. This appointment marked a break with the past, because it was for the first time that an agricultural scientist was given this assignment. An important development during this period was the emergence of Co-ordinated Research Projects on various crops. These projects integrating different disciplines and different institutions/universities constitute an effective national grid of co-ordinated experiments.

A full-fledged Division of Education was created in the ICAR in 1966. Dr O. P. Gautam, an eminent agronomist and educator, joined as first Deputy Director-General (Education). His contribution over the past 12 years towards the development of agricultural education in the agricultural universities is monumental. He worked with dedication and built a friendly and constructive relationship with all the agricultural universities and State Governments. Today every major state except Jammu & Kashmir has an agricultural university where education, research and extension education have been functionally integrated. To meet the needs of skill, for training of rural youth and practising farmers, Krishi Vigyan Kendras were started. A number of fellowship and scholarship schemes for staff development and student welfare projects were also started.

Dr B. P. Pal retired in 1972 and was succeeded by Dr M. S. Swaminathan, who has the distinction of heading the ICAR for a period

of over seven years. Dr Swaminathan is an eminent geneticist with a deep understanding of the problems of agricultural production. He worked with a sense of dedication for the ICAR. He improved the service conditions of the agricultural scientists. The credit for institution of the Agricultural Research Service goes to him. The pay scales of scientists were improved. It also enabled the scientists to continue in their fields of specialization, where they may get the highest salary possible within the organization. It also facilitated mobility of scientists from one institute of the ICAR to another and also to sister organizations like universities, CSIR, BARC, etc.

Mr Jagjivan Ram was the President of ICAR for two spells of three years and two years, viz. 1967-1970 and again from 1974-1976. In addition to Agriculture he also held the portfolio of Irrigation. Mr Jagjivan Ram is known for his strong common sense and clarity of thought. He gave support to the ICAR in starting the Agricultural Research Service. He wisely managed the problems of food production.

Mr Fakhruddin Ali Ahmed was the President of ICAR from 1970 to 1974. Polished, suave and polite, Mr Ahmed gave support to the ICAR. This was the period during which the Green Revolution passed through a period of rise and later on of decline. An unprecedented success was achieved in the production of cereals, and the decline started in 1972 owing to abnormal rise in the prices of inputs.

In 1976 Mr Jagjivan Ram instituted a Committee under my chairmanship to review the working of the agricultural universities and to suggest improvements. This Committee made many useful recommendations which, when implemented, would improve the working of agricultural universities.

In 1977 elections, Congress Party was defeated and Janata Party came to power at the Centre. S. Parkash Singh Badal, a practical farmer of the Punjab with a deep insight into the problems of agriculture and great sympathy for farmers became Minister for Food, Agriculture and Irrigation. After a few months stay at Delhi, he preferred to return to the Punjab, and became the Chief Minister. He was succeeded by S. Surjit Singh Barnala, an advocate and farmer, who had served previously in the Punjab Cabinet as a successful Minister for Education. S. Surjit Singh has initmate knowledge of agriculture and knows the hardships that the farmers face. In the complex apparatus of the Government, he has been exerting his influence to alleviate the distress among the farmers, which has particularly affected the growers of

sugarcane, cotton and potatoes etc., He is ably assisted by Mr Bhanu Pratap Singh. Minister of State for Agriculture, who has practical experience of farming and who is fully conversant with the difficulties which the farmers are currently facing.

The ICAR has emerged as one of the leading agricultural research organizations in the world. It has 30 research institutes, two national bureaux, and a central staff college under its jurisdiction. Besides, it has the responsibility of fostering and supporting the growth and development of 21 agricultural universities. In respect of these universities, the ICAR functions in the same manner as the University Grants Commission with regard to traditional universities. The ICAR is thus unique in having concurrent responsibility both for research and education. The future of agriculture and welfare of farmers depends upon the support that the ICAR receives from the Government of India. Let us hope that it would be forthcoming generously so that our agriculture makes further progress to meet the challenge of rising population.

M. S. RANDHAWA

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I am grateful to the Director of National Archives, New Delhi, for providing material on the history of the ICAR. Dr Kishan Singh Bedi edited some of the chapters. Layout of the illustrations has been provided by the Art section of the Publications Division of the ICAR under the guidance of Mr M. K. Bardhan.

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CHAPTER 1

# AN ATTEMPT TO CREATE A DEPARTMENT OF AGRICULTURE AND HOW IT ABORTED

1866-1881

It must be admitted that the British Empire in India was by no means a philanthropic organization, and the primary interest of British Government was to safeguard the interest of their nation. The administrative set up was dominated by bureaucrats trained in revenue. Few among them had knowledge of natural science and aptitude for dealing with agricultural questions. The stock argument put forward was that the farmer knew his business and was not in any need of guidance or help. Hence, need of experts in agriculture was not recognized. Moreover, they believed in the theory that the expert should not be on the top. He should be down below so that his knowledge could be tapped.

It was in 1866, on the conclusion of the work of the Bengal and Orissa Famine Commission, that the policy of having a special department to watch over the interests of agriculture was first mooted. Lord Lawrence, the Governor-General, thought the step premature.

There are always exceptions to the rule and there were men of conscience among the British who could not be indifferent to the welfare of Indian masses. Among these can be counted Lord Mayo, and a civilian of the Bengal Civil Service, Allan Octavian Hume, his adviser. An unconventional civilian, Hume was a naturalist who specialized in the study of birds, and later on turned theosophist under the influence of Madam Blavatsky and Col. Olcott. Incidentally, Hume was also the founder of the Indian National Congress.

Out of the British rulers of India, Lord Mayo (1869-1872) was the only one who had been a practising farmer. A squire's son, he lived at Hayes, about 35 km from Dublin. As a boy he had great interest in natural science. He collected fossils and made a small private museum. When he grew up, his father gave him a farm to manage. He set about in right earnest, draining and improving the farm, attending markets, selling cattle, and he took interest in stock-breeding and farmers' clubs.

When he came to India, he wrote to Lord Napier, 'the time has come when we ought to start something like an agricultural department in the Government of India, with branches in the Presidencies

and the Lieutenant-Governorships. Agriculture, on which every one here depends, is almost entirely neglected by the Government. I have seen enough already in my wanderings to know that there is an enormous field, not exactly for the reform, but for the investigation of husbandry in India.'[1]

DEMAND FOR DEPARTMENTS OF AGRICULTURE

A demand for establishing Departments of Agriculture in the Provinces came not from Indians, but from British industrialists. Textile industry of Manchester was facing a crisis due to the stoppage of cotton supply from the United States of America on account of civil war which ravaged that country during 1863-1864. The Cotton Supply Association of Manchester exerted pressure upon the Secretary of State for India to devise ways and means to improve the supply of cotton to the textile mills of Manchester from India so that dependence on the USA might be minimized. They submitted a Memorial to the Secretary of State on 12 March 1869, in which they prayed:

Notwithstanding the renewed exertions of the United States since the close of the Civil War, we have still to deplore the long-continued scarcity of cotton and the consequent losses and sufferings experienced by our manufacturers and the operatives dependent upon them for employment. There appears to be little probability that the production of cotton in America will, for many years to come, be adequate to the requirements of this and other countries. Your memorialists therefore believe that India is the great source to which they must look for the large supplies that are so urgently needed, and the best and speediest means of obtaining them is now engaging their anxious consideration. The Association has, upon previous occasions, pressed upon the Government the establishment of a Department of Agriculture in each of the Provinces of India. They would now again urge the establishment of such a department, to which the reports of Collectors or Cotton Commissioners would be made, which reports would afterwards be communicated by it to the public. By this means information of great value and importance would be obtained, and the interests of the agriculturists and the manufacturer alike be benefited.' The memorial concluded with the remarks:

'That the present state of the cotton trade in Lancashire and other districts is an urgent argument for the immediate adoption of the

[1]Hunter, W. W. *A Life of the Earl of Mayo, Fourth Viceroy of India*, Vol. II, pp. 319, 320

measures suggested by the Association. The inadequate supply of cotton has raised the price so high that the manufacturers find it impossible to escape from great loss in their operations, and mills are gradually closing or going upon short time, while the operatives are driven to emigrate or become a burden upon the local rates'.

The lobby of the Cotton Association was powerful and the Secretary of State could not ignore what the Association had suggested in the Memorial. Hectic consultations followed between the Secretary of State and Lord Mayo, which resulted in the formulation of a despatch by the Governor-General on 6 April 1870, addressed to the Secretary of State. A part of this despatch ran as follows:

'The experience of the last few years has led us to the belief that much administrative and material advantage would be obtained for our Indian possessions, if more systematic measures were taken for securing constant and intelligent efforts, on the part of this Government, for the improvement and development of the agriculture, commerce and industrial arts of India. We are satisfied that closer attention should be given to the great products which constitute the staples of our agricultural and manufacturing industry, and of our export trade. We are thus brought to the conclusion that the formation of a separate department of the Government for the care of these great interests ought no longer be delayed. Such a department would take cognizance of all matters affecting the practical improvement and development of the agricultural resources of the country.'

In para 27 of this despatch, Mayo proposed the creation of a Department of Agriculture and Commerce and the post of a Director-General of Agriculture and Commerce. He stated, 'We propose to constitute a Department of Agriculture and Commerce as a separate branch of the Home Department and to place it under the supervision of a specially qualified officer, to be called Director-General of the Department of Agriculture and Commerce. We would give to this Officer a salary of Rs 3 500 p.m. He would hold a position in the Home Department analogous to that held in the Public Works Department by the Inspector-General of Irrigation. To this branch of the Home Department would be transferred all that portion of the business of the Home, Financial and other Departments which is connected with the subjects which have now been indicated. The functions of the Director-General of the new Department would embrace all matters connected with the administration of the land revenue, salt and opium, with the development of all branches of the material resources of the

country, and with statistics of every description.

'We are satisfied that the measures which we desire to take would be highly beneficial to the country, and that we might reasonably anticipate that they would ultimately lead to an important increase of the revenue.'

AGRICULTURAL BUREAU

Lord Mayo's original conception of this Department was as a purely Agricultural Bureau, presided over immediately by a Director-General of Agriculture and not by a Secretary. He intended the Director-General to be supreme in his own Department. Hume explains:

'The Director-General was to have immediately under him a small staff of experts, and was to keep up only just such an office as was absolutely unavoidable. There was to be as little writing and as much actual work as possible. Directors of Agriculture were to be appointed in each province, also to be aided by experts. They were to work partly through the direct agency of farms and agricultural schools, and partly through the revenue officials of all grades down to the village accountants. The Director-General was to be moving about generally whilst the crops were on the ground. He was to confer personally with all the Provincial Directors and their Governments, go thoroughly with the aid of his staff into all their projects and schemes, make himself fully acquainted with local wants and wishes, and then during the hot season join the Government of India, and lay before it as succinctly as possible all that was desired with his (and his experts') opinions and recommendations.'[2]

DEPARTMENT OF REVENUE, AGRICULTURE AND COMMERCE

The Secretary of State showed general agreement with the Governor-General on the creation of the Department but objected to the creation of the post of Director-General under the control of Secretary, Home Department. He remarked: 'The proposed department, if established, should be designated the 'Department of Revenue, Agriculture and Commerce'.

The Governor-General reluctantly agreed to the suggestion of the Secretary of State. In his letter of 22 February 1871, he informed the Secretary of State: 'In conformity with Your Grace's opinion that the new Department should have a separate and independent

[2]Hume, Allan. *Hints on Agricultural Reform in India* (Indian reprint), p. 15

position, instead of, as originally proposed, being placed under a Director-General in subordination to the Secretary in the Home Department, we have come to the conclusion that it should be placed under a Secretary in the Department of Revenue, Agriculture and Commerce, *whose position should be precisely analogous to that of other Civil* Secretaries.' The Secretary of State approved the proposal formally made by the Governor-General on 27 April 1871. He wrote, 'It is with much satisfaction that I convey to your Government the approval of Her Majesty's Government of the scheme which you have described in your despatch under reply.'

Hume was made the Chief Secretary in the Department of Revenue, Agriculture and Commerce. A scheme was prepared for agricultural development including a Director-General and seven Directors, and their staff and offices and 40 model farms with schools or colleges, etc. The net expenditure of this scheme was estimated as 2.5 million rupees with another 2.5 million for offices and buildings etc. These funds were not provided.

The *proposal to send out a specially trained officer as Director*-General of Agriculture was not sanctioned, but in his place an Additional Secretary was added to the Government of India and placed in charge of revenue, agriculture and commerce. No scientific officers were employed either by the Government of India or in provinces. Nothing in the way of agricultural development was achieved and attention was limited entirely to the collection of statistics.

The Department of Revenue, Agriculture and Commerce proved ineffective. Writing in 1879, Hume thus explains why it had not done anything material for the improvement of Indian agriculture. 'Though originally designated the Department of Agriculture, etc., this Department has never, from the first, been so constituted as to permit of its dealing either directly or efficiently with agricultural matters.

'Lord Mayo clung, however, to the idea of ultimately making this really a Department of Agriculture, but the Secretary of State did not approve of even this.

'Lord Mayo named it the Department of Agriculture, Revenue and Commerce. The Secretary of State objected to this, said that Revenue, and not Agriculture, was the main object of the Department, and ordered the name to be altered to "Revenue, Agriculture and Commerce."

'Lord Mayo selected as head of the Department an officer whom

from his own thorough knowledge of the subject, he ascertained to be well versed in practical European agriculture, who had, for his own information and amusement, farmed in a small experimental way throughout his many years of service in India as a District Officer, and who was fairly conversant with all the then more modern German and English writings on the theory and practice of agriculture.

'The Secretary of State remarked (replying as it were officially to what Lord Mayo had written to him on this subject privately or demi-officially) that the next head of the Department was to be chosen for his knowledge of revenue and not of agricultural matters.

'It will be seen, therefore, that, as constituted, this Department never was, and never was intended by the Home Government to be, a Department of Agriculture. Lord Mayo hoped to convert it into this, but with his death India lost the warmest, most competent, and, at the same time, most influential advocate for agricultural reform. No change, such as he contemplated, has ever been made in the constitution of the Department, and succeeding administrations have only made the official bonds more rigid, and converted its chief more and more thoroughly into a mere desk-tied Secretary.

'A Secretariat is under no circumstances the form of organization best suited to the promotion of agricultural development. Still even a Secretariat might do much if it possessed three needful adjuncts:

1 Competent advisers, not tied to an office, but able to move about, collect and digest the necessary facts, and put schemes before it in a shape in which sound decisions can be arrived at.
2 A qualified agency, either of its own, or belonging to administration subordinate to it, to give effect to its decisions.
3 Money to expend in giving effect to these and in experiments, etc.

'The Department of Revenue, etc., has never had anyone of these three requisites at its command.

'The only person connected with it from first to last who has possessed any knowledge of both the theory and practice of agriculture has been the Secretary, who has had always from eight to ten hours a day (and often much more) office work, and who for ten years has barely seen a field, except from the train, on the occasion of the half-yearly migration of the Government of India between Simla and Calcutta.

'It has never had any agency, though the creation of a Directorship of Agriculture in the North-Western Provinces in recent years has

at last originated a nucleus, in one province, out of which such an agency will, it is to be hoped, develop. Last, but not least, it has had no money.

'How it comes that the Government should have no money to spend on improving the one branch of industry to which it chiefly owes its revenue, will be briefly discussed further on. At present it is sufficient to say that it had not the money to give.'[3]

REVENUE AND AGRICULTURE DEPARTMENT

In 1879, under the stress of financial pressures, work relating to agriculture was amalgamated with the department dealing with Revenue, Home, Commerce and Finance and the Department was known as Home, Revenue and Agriculture Department. This arrangement continued till 1881. In 1881 Revenue and Agriculture were separated from Home and formed into a separate Department known as Revenue and Agriculture Department.

[3]Hume, Allan. *Hints on Agricultural Reform in India* (Indian reprint), Calcutta, 1879, pp. 12, 13, 14

CHAPTER 2

# DEPARTMENTS OF AGRICULTURE IN PROVINCES: ORIGIN

Famines and Famine Commission Report (1880); Dr J. A. Voelcker's Report on Improvement of Indian Agriculture; Viceroyalty of Lord Curzon (1898-1905); Birth of Imperial Agricultural Research Institute, Pusa; Establishment of Department of Agriculture; Establishment of Civil Veterinary Department (1889), Veterinary Research and Education (1890-1908)

IT has been the experience of weather experts that there were two bad seasons to every seven good ones in India. Disastrous famines occurred at intervals of about 12 years in the nineteenth century. There were seven great famines in the last century, affecting at least 200 million people. In the famine of 1876-78 about 60 million people were affected, and mortality exceeded 5 250 000. This famine led to the institution of the Famine Commission of 1880.

## FAMINE COMMISSION REPORT (1880)

The Famine Commission Report of 1880 revived interest in improvement of agriculture. It recommended that improved agriculture should be the main step for obtaining security against disastrous failures in food supply. The Famine Commissioner's scheme contemplated a central department controlled by the Imperial Secretariat, but they insisted on the absolute necessity of the simultaneous formation, in each province, of a Department of Agriculture, with a large subordinate establishment under an executive officer. This part of their proposals was indeed the cornerstone of the main administrative reforms which they projected. Sir Edward Buck was appointed Secretary and under his guidance the development of provincial agencies was taken in hand. Agricultural enquiry, agricultural improvement and famine relief were laid down as the primary duties of the new departments, and directors of agriculture were appointed in most provinces.

Between 1881 and 1889 various questions were considered. The appointment of an agricultural chemist to the Government of India was discussed and a proposal to attach an agricultural branch to the Dehra Dun Forest School and to utilize it as a National School of Agricul-

ture for northern India was considered, but the proposal came to nothing.

## DR J. A. VOELCKER'S REPORT ON IMPROVEMENT OF INDIAN AGRICULTURE (1891)

In 1889 the Secretary of State expressed his willingness to send out a competent agricultural chemist who should make enquiries in India and advise upon the best course to be adopted for (*i*) applying the teachings of agricultural chemistry to Indian agriculture, and (*ii*) to effect improvements in Indian agriculture. The need of an agricultural chemist was felt as there were large tracts of unculturable land in the North-West Provinces (present Uttar Pradesh) which were infested with noxious salts, and it was thought that science might aid in reclaiming these lands. The selection of an expert was entrusted to Sir James Caird who had been one of the Famine Commissioners. Sir James Caird selected Dr John Augustus Voelcker, Consulting Chemist of the Royal Agricultural Society of England, who arrived in India on 10 December 1889 and left early in 1891.

Dr Voelcker toured all over India, meeting representatives of all provinces and the record of his journeys and impressions is contained in his report, *Improvement of Indian Agriculture*. He did not share the commonly held view that Indian agriculture was primitive and backward. He believed that in many parts of India there was little or nothing that could be improved, while where agriculture was manifestly inferior it was more generally the result of the absence of facilities which exist in the better districts than of inherently bad systems of cultivation. That improvement, however, was possible was clear from the differences of agricultural conditions and practices found in different parts of India. Therefore, he recommended systematic prosecution of agricultural enquiry, and the spread of general and agricultural education, and laid down, in considerable detail, the lines on which agricultural improvement was possible.

### Agricultural Enquiry

Stressing the necessity of an agricultural enquiry, he observed, 'As regards India, comparatively little is known of its agricultural methods, and that they have only been, so far, the subject of casual and isolated enquiry by individuals. An organized system of enquiry, on the other hand, might result in the collation of definite knowledge of the agricultural resources and needs of the country. Practical enquiry, or the obtaining of knowledge respecting agricultural practice, pre-

cedes both scientific enquiry and experiment. The scientist, without some knowledge of the practical issues involved, is unable to push his enquiries in the right direction, and however able his researches, he may fail from being unpractical. Similarly, the experimenter, without a knowledge of what is done elsewhere, or of what is within the reach of the cultivator, may waste both time and money in trying what has no chance of ever becoming of any practical value.

'The practical man must first become thoroughly conversant with what is being done in native agriculture, and with the conditions under which it is carried on; then the scientist may come in and explain the rationale of the practice, and may apply these principles to the extension of the better systems, and to the discovery of further resources; finally, by the happy combination of science and practice, the work of experiment may proceed in a definite and useful direction. In this way some advance in agriculture may be made.

'I believe that it will be possible here and there to graft on to native practice the results of Western experience, but the main advance will come from an enquiry into native agriculture, and from the extension of the better indigenous methods to parts where they are not known or employed.'

Real progress came only when it was realized that in India agricultural practice had been built up on the traditional custom of years, and in which reside, though unexpressed and unexplained, deep scientific principles, the reasons for which can only gradually be elucidated.

FIELD OF ENQUIRY

Defining the special problems which deserved investigation, Voelcker observed,

'Firstly, it is important to ascertain the requirements of each district in regard to the provision of water, of manure, of wood, and of grazing, and to decide in what way the needs can best be met; whether, for instance, irrigation by canal or by wells is best suited; whether embanking of land should be done; whether "fuel and fodder reserves" can be usefully formed; where grazing can be provided; whether the *taccavi* system of advances for agricultural improvement is properly brought before the people and utilized by them; and so on.

'Secondly, it is desirable to ascertain where a transference of the practice of one part may be beneficially made to another part. Of this nature are, the embanking of land; green-manuring; hedging and enclosure of fields; sheep-folding; the use of leaves; the growing of fodder-crops; the ploughing of rice fields after harvest; the use of

castor and other oilseed refuse as manure; the utilisation of night-soil and town-sweepings; the planting of sugarcane in furrows; the use of the iron sugar-mill and shallow evaporating-pan in sugar manufacture; the extended growing of sugarcane, potatoes and other crops.

'Thirdly, there are a number of questions of a practical nature which await solution, and which, though mainly of the nature of experiment, cannot proceed without first employing practical enquiry. Such questions are: What is the outturn of different crops; What is the right amount of seed to use in sowing rice? What quantity of water should be employed in rice cultivation? Does manuring of rice fields pay? Would draining of rice fields be advantageous? What is the relative outturn of sugar from different varieties of cane? Does continuous growing of sugarcane pay? Will it pay in the long run to grow a long-staple variety of cotton rather than the short-staple varieties generally grown? Is interculture of other crops with cotton profitable? Is the use of bones advantageous?

'Lastly, there are points more connected with the introduction of foreign agricultural practice; for example, the possibility of introducing new crops; the growing of new varieties; the acclimatisation of seed, the selection of seed; the making of silage; the use of new implements; the use of litter and preservation of urine; the better conservation of cattle-manure; the reclamation of salty land (*usar*), of ravine and other wastelands.'

## Need of an Expert Agency

To carry out the enquiry, he stressed the need of an expert agency. He observed, 'The enumeration of the subjects set out in the last paragraph clearly points to the necessity of having an agency of an expert nature to deal with them. They are not matters which administrative genius, a high intellect, or even ordinary common sense can decide, but which need the application of special technical knowledge of agricultural conditions and practice.'[1]

A conference of provincial delegates was held to discuss these proposals. The possibilities of improvements, it was agreed, were sufficiently great to justify the gradual establishment of a sound system of scientific investigation and of agricultural education. For the general character of this system it was agreed that an expert was required for scientific investigation apart from the requirements of agricultural education, and great stress was laid on the importance of having

[1]Voelcker, J. A. *Improvement of Indian Agriculture*, pp. 296-9

a man able to deal with the practical side of agricultural questions and competent to direct general enquiries. The conference concluded by advising the appointment of a really first-class man as agricultural chemist for the conduct of general investigation and an assistant for purposes of instruction. An agricultural chemist and an assistant chemist were accordingly selected and arrived in November 1892. The duties of the senior officer were research; of the junior, teaching at Poona, Dehra Dun and Saidapet and the disposal of questions connected with forests and agriculture. Thus, in a modest way, was laid the foundation of a scientific staff for the Department of Agriculture.

The next decade saw a marked development on the scientific side of the work. The need for something more than chemistry was being felt, and interest in agricultural development was increasing in the provinces. Agricultural science, moreover, was becoming better organized in Europe.

INSPECTOR-GENERAL OF AGRICULTURE (1897)

In 1897, in view of the considerable development in the provinces, it was thought that the time was ripe for the appointment of an Inspector-General of Agriculture, but great difficulty was experienced in finding a suitable man and it was not till 1901 that the vacancy was filled by the appointment of J. Mollison, who had done excellent work as a Deputy Director of Agriculture in Bombay. His duties were to act as an adviser in agricultural matters both to the Imperial and Provincial Governments. Attention was directed to the expansion of the Imperial department, which, at this stage, consisted only of an agricultural chemist in addition to the Inspector-General of Agriculture. A cryptogamic botanist, later known as the Imperial Mycologist, was added in 1901, and an entomologist in 1903.

VICEROYALTY OF LORD CURZON (1898-1905)

George Nathaniel Curzon, after Mayo, was the next Viceroy with a background of farming. His father had an estate in Derbyshire. In 1895 he married Mary Victoria Leiter, daughter of Levi Leiter, a Chicago millionaire. This link with America not only provided him with a wife, but also brought him in touch with American agriculture and with another American millionaire, Henry Phipps.

At 39 Curzon became the Viceroy of India. He was dynamic, imaginative and extremely industrious. His worst fault was complete inability to delegate authority. He was so conscious of the inferiority of others that he had to do everything himself. His greatest work

was the organization of the Archaeological Survey of India and protection and preservation of India's ancient monuments.

FAMINE (1899-1900)

A year after he became Viceroy, Curzon had to deal with the famine of 1899-1900, the most severe on record. All the western part of India, the Deccan, including the Nizam's dominions, the Central Provinces, the Central India Agency, the Bombay Presidency including Gujarat (comprising Kathiawar, Cutch and Baroda), Sind, and Rajputana and the Punjab, especially the southern part, were hit by this awful famine. Mr John Elliott, in his careful forecast of the monsoon of 1900, before the famine was at its worst, stated that the drought of 1897 extended over a larger area and was more severe than had occurred during the previous 200 years. Judged from the data collected by the Famine Commission, the drought of 1897 and the subsequent famine of 1899-1900 were unique in their extent of area and probably also in their intensity. No such complete failure of the rains, after the first month of the monsoon, was on record.

J. E. Scott, an American missionary commented, 'The misery is terrible. But still worse is the fearful emaciation. Living skeletons are on every side. The barren lands of the Deccan, none too rich at best of times, are fast being turned into tracts of dismal, sun-cracked, desert-charred earth, whose friable edges are caught by the wind and sent flying in clouds of pungent dust. No water in the wells; no water in the rivers. This is the report that comes in from the districts, and you can easily test it for yourself....The central horror of this famine lies in the fact that the misery and torment of a water famine have to be endured, together with a famine of food for people and fodder for beasts. Coming farther north, the whole of the Central Provinces were overwhelmed by it. When the famine was at its worst, in August, nearly two and a half million people were on relief works (about a fourth of the population). All that part of the Central Provinces in the northern part of the Deccan, between the Narbada and the Godavari, was dried up.'[2]

This famine convinced Lord Curzon that the Government of India must pay urgent attention to agriculture. As a consequence, an Imperial Agricultural Research Institute was founded at Pusa in Bihar and Departments of Agriculture were established in the provinces.

[2]Scott, J. E. *Famine Land, Observations and Experiences in India during the Great Drought of 1899-1900*, pp. 31, 32

## BIRTH OF IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, PUSA (1905)

A proposal emanated from the Government of Bengal in 1905 to utilize a large Government estate at Pusa in the Darbhanga district of Bihar as a provincial research station and college. At that time Bengal included Bihar and Orissa. The Government of India considered that this site might suit their needs and, with the full concurrence of the Government of Bengal, the estate was taken over for the purpose of an agricultural research institute, an experimental farm and an agricultural college. At this juncture a generous donation of £20 000, to which £10 000 was subsequently added, was made to the Viceroy by his friend, Henry Phipps of Chicago. This gift was tendered when the extensive development of agricultural departments was under consideration and Lord Curzon decided to devote the greater portion of it to the equipment of the new research institute.

### WELFARE OF FARMERS

Curzon's next interest was in the farmers of India. He relaxed the rigidity of the revenue system and introduced a new procedure in 1905 for granting remissions and suspension of land revenue in bad seasons. He protected the farmers of Punjab from expropriation by money-lenders by the Land Alienation Act of 1900. He also paid attention to the debt problem of the farmers and passed the Co-operative Societies Act of 1904.

He constituted an Irrigation Commission, which laid down a long-term programme for the development of irrigation in India.

### ESTABLISHMENT OF DEPARTMENTS OF AGRICULTURE

The resolution of the Government of India of December 1881 defined the functions of the Provincial Agriculture Departments as agricultural enquiry, improvement and famine relief. In practice, statistical enquiries and management of famine relief became the primary concerns of the Departments. The subject of agriculture was combined with land records and settlement work.

Lord Curzon's viceroyalty marks the beginning of a new era—of growth of agricultural departments both at the Centre and in the Provinces, and the despatch of the Government of India of 4 June 1903 provided its keynote. In 1905 the Government of India decided to set apart annually a sum of Rs 2 million to assist the development of agricultural research, demonstration and education in the provinces. Full-time Directors of Agriculture were appointed in all the major

provinces. The provinces were divided into a suitable number of 'Circles' and each was to have an experimental farm on the basis of regional differences of soil and climate under a Deputy Director of Agriculture. These farms were to function also as depots for seeds, manures and implements.

ESTABLISHMENT OF AGRICULTURAL COLLEGES (1905)

With the annual grant of Rs 2 million it was contemplated to establish, in each important province, an agricultural college and research station adequately equipped with laboratories and class-rooms, to which would be attached a farm of suitable size. The superior staff proposed at each of these provincial institutions was an expert agriculturist, an economic botanist, an agricultural chemist, an entomologist and a mycologist—one of the members of this staff discharging the duties of principal of the college. The staff was to combine teaching with research. It was held that research could ordinarily be more active and better sustained if associated with lecturing, because this would check any tendency to the investigation of problems unlikely to lead to practical results. To enable the experts to carry on research and to tour, an adequate number of assistants and demonstrators were to be provided. They would also assist in teaching so that the time of experts might not be wasted in elementary tuition.

To direct the work, civilian directors were appointed in all the larger provinces. But the expansion of staff was not as rapid as was anticipated. It was held that the backbone of the scheme was the educational aspect, and the establishment sanctioned for each of the provinces was limited to an all-round agriculturist as principal of the college, an agricultural botanist and an agricultural chemist. In the words of Lord Morley, the creation of provincial colleges having the above-mentioned staff would remain a primary feature of the scheme. Colleges were accordingly reorganized or started at Pune, Kanpur, Sabour, Nagpur, Lyallpur and Coimbatore.

AGRICULTURAL RESEARCH

However desirable the establishment of colleges may be, it was clear that, apart from teaching, there was an enormous amount of experiment and research to be done if agriculture was to be improved. Officers were necessary for the superintendence of farms for experiment, and for the supervision of demonstration and seed distribution. The duties of such officers could not be carried out satisfactorily by experts who were tied to their headquarters by educational duties. To

meet this want, deputy directors were appointed. The importance of a staff of entomologists and mycologists for the larger provinces was again emphasized. It was pointed out that the annual losses from wheat rust amounted to £2 million, whereas from bollworm in the Punjab there had been a loss of £1.5 million in a year. The addition of entomologists and mycologists was, however, considered by the Secretary of State to be premature, because it was thought that the Imperial Entomologist and Mycologist could undertake important investigations for the provinces and could train Indian assistants.

DEPARTMENTS OF AGRICULTURE IN THE PROVINCES

*Bombay.* A Director of Agriculture was appointed in 1883, and, although his duties for the first decade were largely sta istical, agricultural work was not neglected. In 1890 a post of Superintendent of experimental farms was sanctioned, and work on the improvement of agriculture on scientific lines was commenced. J. Mollison was appointed to the post and under his capable administration the department was organized and the subordinate staff which he trained reached a high degree of efficiency. Another capable director who left a mark was Dr Harold H. Mann. Dr Mann got his B.Sc. degree from Victoria University of Manchester in 1892. He was Chemical Assistant for research under Dr J. A. Voelcker and he organized the laboratory and pot-culture station at Woburn in England, in 1898. He came to India as the first Scientific Officer of the Indian Tea Association in April 1900. In 1907 he was appointed Principal of the College of Agriculture at Poona. In 1921 he became Director of Agriculture, Bombay Presidency. His studies of Deccan villages are well-known.

*Madras.* To Sir William Denison, Governor of Madras, has the credit of founding in 1863 the Madras Department of Agriculture. But his Government fell into the mistakes of turning for aid to the West, and their first act was to order from England a steam plough, some harrows and cultivators, seed-drills and horse-hoes, threshing-machines and winnowers, chaff-cutters and water-lifts.

To find employment for this elaborate consignment, Saidapet farm was started in 1864 and entrusted, as a 'model farm', to a committee of amateur enthusiasts, who undertook to conduct (*i*) a full trial and exhibition of the agricultural implements received from England; (*ii*) a full trial of artificial manures; and (*iii*) an exhibition to the people of the improved system of agriculture.

This committee laboured on heroically at its great task till 1871, when it was dissolved and the farm passed to official control.

A farm was opened in 1904 for the study of groundnut in South Arcot District and another on the West Coast to investigate the diseases of pepper, and these farms were managed by revenue inspectors trained by, and working under, Benson, Deputy Director of Agriculture, a trained European expert.

*Uttar Pradesh.* In the North-Western Provinces of Agra and Oudh (now the Uttar Pradesh), in 1874, the Lieutenant-Governor, Sir John Strachey, who had been a member of Lord Mayo's Government, established a Provincial Department of Agriculture. Sir Edward Buck was the first Director, and his name will go down to posterity as the pioneer of agricultural progress in India.

The Cawnpore (Kanpur) farm, one of the oldest farms in India, was extended; a tobacco farm was started at Ghazipur, a silk farm in the Dun, and a fruit farm in the Kumaon Hills.

An agricultural school was opened at Kanpur, and a Deputy Director of Agriculture was appointed in 1901.

*Bengal (including Bihar, Orissa and Assam).* A Director of Agriculture with three assistants trained at Cirencester was appointed in 1881, and experimental farms were started on Court-of-Wards' estates. The Sibpur farm, started in 1887-88, unsuitable on account of variability of soil, was the central part of the scheme. It was abandoned in 1898.

*Central Provinces.* The Agri-Horticultural Society of Nagpur, started in 1862, marks the commencement of agricultural development in the Central Provinces.

The Department was reorganized in 1904. It became a centre for the dissemination of agricultural knowledge and for agricultural education among Government officials.

*Punjab.* The Punjab Government interested itself in the development of agriculture after 1881, when the Famine Commission Report was published. When a Director of Agriculture was appointed he was mainly concerned with statistics and the organization of a subordinate revenue establishment. For the rest a number of disconnected agricultural experiments were carried out on a small scale, such as trials of exotic varieties of cotton, wheat and maize, practically all of which ended in failure. In 1901, 22.5 ha of land at Lyallpur was turned into a farm and in 1902 three agricultural assistants trained at Kanpur started work there.

Reviewing the record of achievements in the provinces up to the beginning of the twentieth century, Mackenna observed, 'The vast problems of Indian agriculture were being attacked by a mere handful of isolated workers with no trained staff and no organization to give effect to their recommendations. The general impression one gets from the record of these early efforts is that men were groping in the dark. The problems were so numerous and overwhelming that they did not know where to begin.

'But from the failures which followed many amateur efforts, some useful lessons were learned. It was found that, in many cases, a more hopeful line was the improvement of indigenous varieties by selection rather than the introduction of exotics. If exotics were to succeed, the information at least had been gained that the effects of change of environment were matters of first importance.

'Where environment was suitable, a few notable successes in the introduction of new crops were achieved; groundnut in Burma; potatoes and fruits in the Kumaon Hills; American cotton in the United Provinces. And the lesson also had been learnt that the East had much to teach the West and that it was wrong to assume that the cultivator had no sound reasons for his practice. At any rate the fallacy of foisting western ideas on him, without reference to local conditions, was fully exposed and the fact emphasized that the true line of development was the improvement of indigenous methods.'[3]

## ESTABLISHMENT OF CIVIL VETERINARY DEPARTMENT (1889)

A Cattle Commission was appointed in 1869 and sporadic efforts were made in the provinces from time to time to deal with cattle diseases. With the development of Agricultural Departments in 1882 the question of a Civil Veterinary Department was also considered, and this as finally constituted in 1889 consisted mainly of the military veterinary officers of the horse-breeding establishment and a few other officers. In the earlier stages the new department concentrated attention on horse and mule breeding. In 1903 this work was taken away from it, and since then attention has been mainly given to cattle.

First the department was manned entirely by officers of the Army Veterinary Department, but since 1901 recruits were drawn from veterinary colleges in England. The provincial organization consisted of superintendents, who were members of the Civil Veterinary Depart-

[3]Mackenna, J. *Agriculture in India*, p. 16

ment; deputy superintendents, who were graduates of provincial colleges; inspectors—either graduates or promoted veterinary assistants—and veterinary assistants.

### VETERINARY RESEARCH AND EDUCATION (1890-1908)

A large amount of research work was done by Colonels Pease and Evans, Majors Baldrey and Walker and by Mr Gaiger and Dr Hartley. A camel specialist was employed for the investigation of the camel diseases. The Hissar cattle-breeding farm under Lieutenant-Colonel Farmer attained reputation.

The systematic investigation of the diseases of animals in India began in 1890 when Dr Lingard was appointed Imperial Bacteriologist at the College of Science at Pune. But the climate of Poona was not favourable for bacteriological research or for the manufacture of vaccines and sera. Hence Mukteswar, 21 km south-east of Almora, was selected for the location of the Imperial Bacteriological Laboratory where work in a modest way was commenced in 1895. This institution has been the pioneer in the field of veterinary research in this country.

#### ANTI-RINDERPEST SERUM

Rinderpest has always been the scourge of India, and the necessity of finding a remedy engaged early attention. In 1896 famous bacteriologist, Professor Koch, visited Mukteswar and demonstrated his bile method of inoculation. During the next few years rinderpest and the preparation of a potent serum were the principal interests of the laboratory, and with the discovery of this serum the scale of operations rapidly extended. A temporary stoppage was caused by the destruction of the laboratory by fire in 1899. A new one was soon built and a branch laboratory was also opened at Bareilly so that research work might be carried on during the winter months. The Bareilly laboratory was enlarged considerably so that the manufacture of anti-rinderpest and other sera could go on all the year round. Between 1901 and 1904 the preparation of sera for anthrax and haemorrhagic septicaemia, of black-quarter vaccine and of mallein (the test for glanders) was taken up. In 1908 Dr Lingard retired and was succeeded by the late Lieutenant-Colonel Holmes.

As rinderpest or cattle-plague is the most prevalent disease in India, the main work of the Mukteswar laboratory was the manufacture of anti-rinderpest serum. So popular was the Mukteswar serum that large indents had been received from the Straits Settlements, Egypt and Rhodesia. Vaccines and sera were also manufactured for

haemorrhagic septicaemia, anthrax and black-quarter.

### Veterinary Instruction

For the training of the staff, veterinary colleges were started at Bombay, Lahore, Calcutta and Madras. A course for veterinary assistants was given, and special and postgraduate courses were started for inspectors and deputy superintendents. The teaching was of a thoroughly practical type, and the results were very gratifying.

CHAPTER 3

# BIRTH OF THE ICAR

1929

THE Government of India appointed a Royal Commission on Agriculture in 1926 headed by Lord Linlithgow (who later on became Viceroy of India from 1936 to 1943) to examine the conditions of agriculture and rural economy in India. The Commission felt concerned that as a result of constitutional changes of 1919, viz. the Montague Chelmsford Reforms, the Government of India divested themselves, except to a very limited extent, of all powers of superintendence, direction and control over the administration of 'transferred' subjects to the provincial governments, which included agriculture and veterinary. The administration of central agencies and institutions for research and for professional and technical training was retained as a 'central' subject, but no specific provision was made for co-ordinating the work of these with those of similar institutions in the provinces. Thus the provincial departments had, in the all-important matter of research, been left without the stimulus of a central organization which could guide and co-ordinate their policy. No specific provision had been made in the Constitution of 1919 for co-ordinating research work, either between the central and provincial spheres or between province and province. The Commission felt that there was nothing inherent in that Constitution which prevented appropriate machinery being devised for that purpose.

The Commission recognized the importance of research and stated that the basis of all agricultural progress is experiment. However efficient the organization which is built up for demonstration and propaganda may be, unless that organization is based on the solid foundations provided by research, it is merely a house built on sand.

## RECOMMENDATIONS OF THE ROYAL COMMISSION ON AGRICULTURE PROPOSING THE CONSTITUTION OF THE ICAR

The Commission proposed that an Imperial Council of Agricultural Research should be constituted, the primary function of which would be to promote, guide and co-ordinate agricultural research throughout India. It would not exercise any administrative control over the Imperial or provincial research institutions. It would be a

body to which the Imperial and provincial departments of agriculture could look for guidance in all matters connected with research and to which such research programmes as they might choose would be submitted for criticism and approval. The Commission stated that their object in proposing the constitution of such a body was to provide provincial governments with an organization embracing the whole research activities of the country, veterinary as well as agricultural, in which they could feel that they had a real and lively interest. That interest would undoubtedly be greatly accentuated if the Council was entrusted with the administration of funds with which it could supplement provincial activities in the matter of agricultural research. They therefore proposed that the Council should be entrusted with the administration of a non-lapsing fund of Rs 5 million, to which additions should be made from time to time as financial conditions permitted.

The Commission further observed that one of the most important functions of the Council would be in regard to the training of research workers and part of its funds should be utilized in the provision of research scholarships tenable by students who had given evidence that they were capable of taking full advantage of an opportunity for intensive training in scientific research in agriculture. The Commission envisaged that the Council would act as a clearing house for information and would establish bureaux for crops as well as for animal husbandry, dairying and veterinary matters. It would also take over the publication work done by the Agricultural Adviser to the Government of India and would arrange for sectional meetings of experts in particular branches of agricultural science.

The Commission proposed that the Council should consist of 39 members. Three of these would be whole-time members: the Chairman, who should be an experienced administrator with a knowledge of Indian conditions, and two eminent scientists qualified to represent respectively the interests of agriculture and animal husbandry. Of the remaining 36 members, eight would be nominated by the Government of India, 18 would represent the provincial, agricultural and veterinary departments, three would represent the Indian universities, two would represent the Indian Central Cotton Committee and the planting community, respectively, and five would be non-official members nominated by the Council, by reason of their scientific knowledge or special qualifications. The Chairman and the two whole-time members might be appointed for 5 years and the

other members for 3 years as a general rule, and provision should be made for extending these periods.

The Commission realized the importance of associating the universities with the research effort and stated that it expected that the universities would take an increasing share in the prosecution of agricultural research. To facilitate it, the Commission suggested the representation of the universities on the Council of Agricultural Research.

### Processing of the Recommendations of the Royal Commission on Agriculture

The Government of India considered the recommendations made by the Royal Commission on Agriculture. Sir G. S. Bajpai, Secretary, Department of Education, Health and Lands, in his note dated 21 June 1928 observed that the scheme must be elastic. It must secure the goodwill of the provinces. It must work efficiently and have a good chance of being accepted by the Indian legislature. He recommended larger expenditure from Central revenues on agricultural research and extension to ensure the co-operation of the provinces. He further recommended setting up of the requisite machinery by executive action, instead of legislation which would have meant delay (Appendix 1).

The recommendations of the Commission were further examined by Dr D. Clouston, Agricultural Adviser to the Government of India, who made many detailed suggestions in his note dated 6 July 1928 (Appendix 1). He observed that the transfer of agriculture to popular control had clogged the wheels of such machinery as previously existed for doing this, and that research on which all progress in developing agriculture must be based had suffered in consequence. He pointed out that since the Montague-Chelmsford Reforms the provincial departments had, in this all-important matter of research, been left without the stimulus of a central organization which could guide and co-ordinate their policy. The Central Government had, it is true, created one such organization, viz. the Indian Central Cotton Committee, of which it had good reason to be proud. Of that all-India organization the Commission spoke in the highest terms, but the organization dealt with one crop only. They had therefore formulated a scheme for the establishment of an Imperial Council of Agricultural Research to deal with agricultural and veterinary research in all its branches. The results obtained by the Indian Cotton Committee had more than justified the action of the Government of India in con-

stituting this body and giving it powers which are ordinarily given only to Government departments. Its success had been largely because there had been no attempt to departmentalize it. The provinces felt that the Committee was looking after their interests with respect to the cotton industry. Every member of the Committee took a practical interest in the development of that industry. In fact, they were selected for that very reason. The policy of the Government of India had, in this case, resulted in great achievements which were benefiting both the cultivators and the trade. He concluded that in the light of the beneficial results achieved by the Indian Cotton Committee the Government of India would be fully justified in establishing on the same lines the research organization with wider powers recommended by the Royal Commission.

Sir Frank Noyce was appointed as an Officer on Special Duty to process the recommendations of the Commission on Agriculture. He submitted that the Government of India should issue a resolution constituting the Council of Agricultural Research as soon as the budget provision had been made and consent of the States to the scheme obtained. He further advised that the Vice-Chairman of the Governing Body of the Council and its Secretary should be appointed concurrently with the issue of the Government of India's resolution. Sir Mohammed Habibullah, Member of the Executive Council in charge of Education, Health and Lands, approved the recommendations made by Sir Frank Noyce on 2 February 1929 (Appendix 1). Lord Irwin, the Viceroy, agreed with Sir Mohammed Habibullah.

The approval of the Secretary of State for India for certain details of the scheme was sought by the Government of India through a telegram dated 24 April 1929. In this telegram it was suggested that the Principal Administrative Officer who would be heading the ICAR should have pay and status of Secretary to the Government. For two whole-time experts on Agriculture and Veterinary a salary of Rs 2500-125-2750 was proposed plus overseas pay Appendix 1).

In view of his special interest in the subject, Sir Frank Noyce also requested that he may be made a member of the Governing Body by name. This was accepted.

The Government of India, Department of Education, Health and Lands, after giving their careful consideration to the recommendation made by the Royal Commission on Agriculture decided to set up the Imperial Council of Agricultural Research by their resolution,

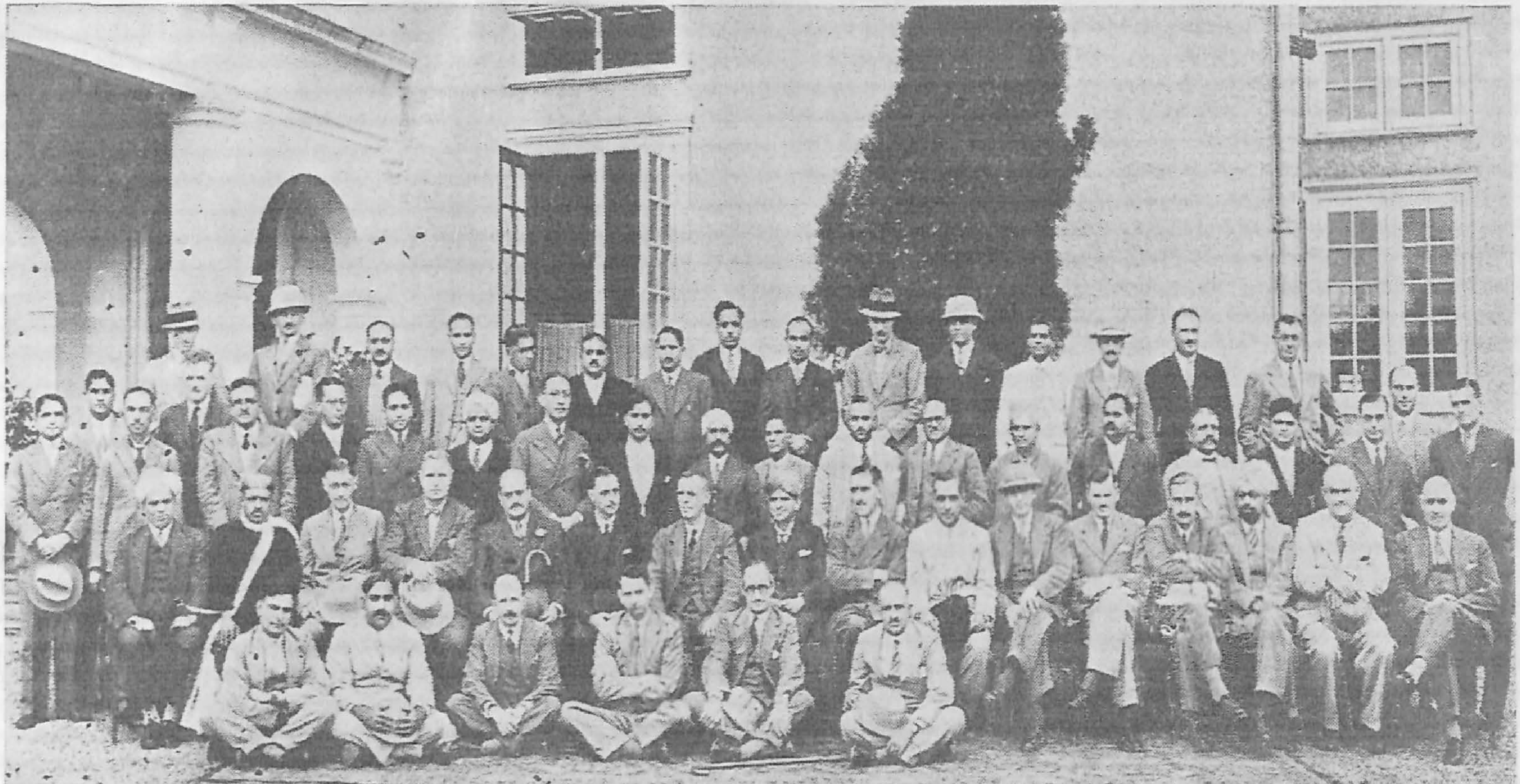


Fig. 1. Photograph of participants of the Tenth Meeting of the Advisory Board of the Imperial Council of Agricultural Research held at Simla on 3 September 1934. Diwan Bahadur Sir T. Vijayaraghavacharya (first Vice-President of the ICAR) seated in the centre (eighth from the left). On his right (seventh from the left) is Sir Bryce C. Burt, first Agricultural Expert to the ICAR, and on his left is Col. Arthur Olver, first Animal Husbandry Expert to the ICAR. Dr B. P. Pal, first Director-General, is fourth from the left (last row)

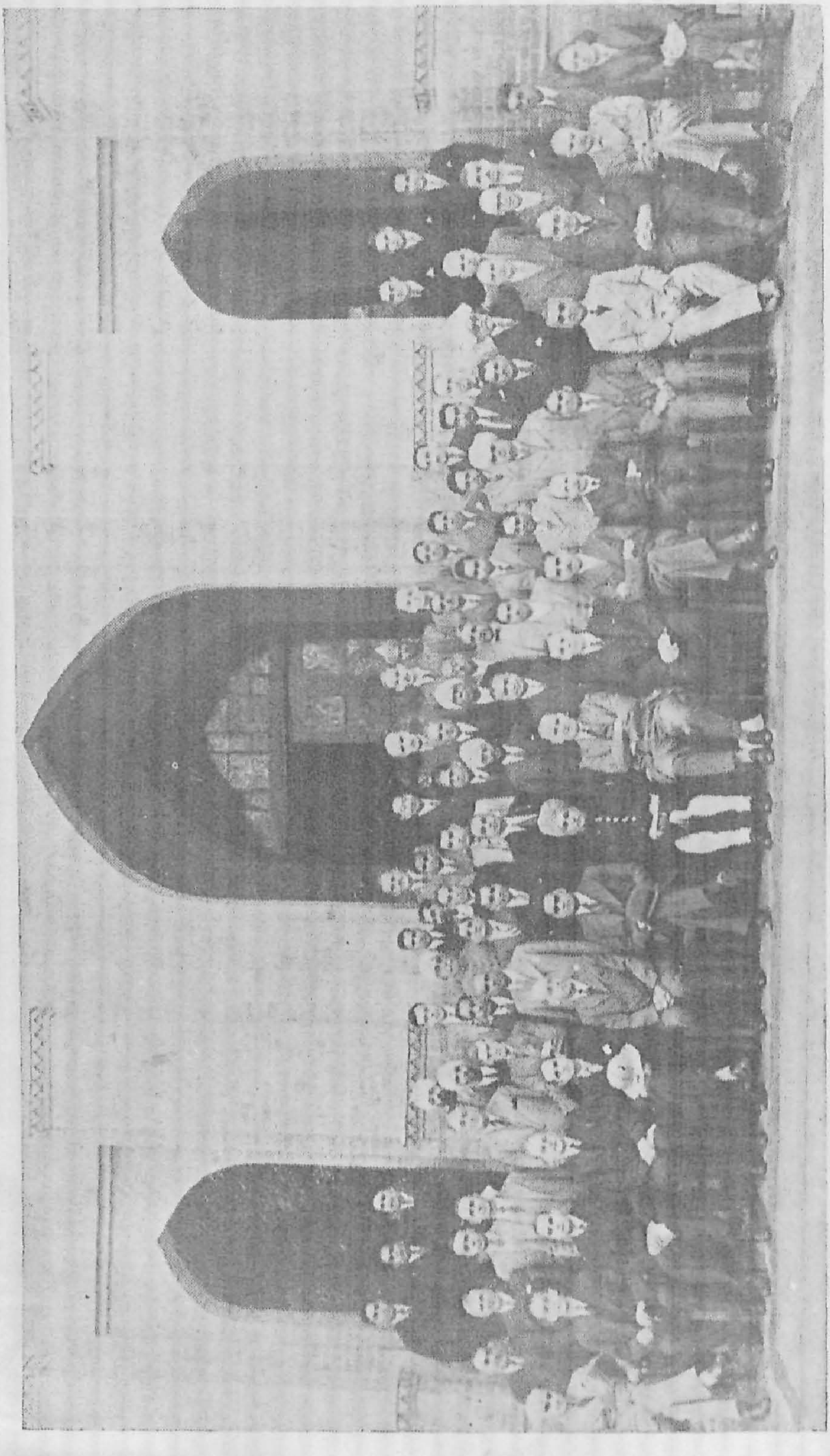


Fig. 2. Photograph of participants of the Second Meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India held at Lahore from 6 to 9 December 1937. H. E. Sir Herbert Emerson, Governor of the Punjab, is seated in the centre. On his right is the Hon'ble Sir Chhotu Ram, and on left are Sir Bryce C. Burt, first Agricultural Expert to the ICAR, Col. Sir Arthur Oliver, first Animal Husbandry Expert to the ICAR, and Dr W. Burns (Agricultural Commissioner, 1935-41). Dr B. P. Pal, first Director-General, is on the extreme right (last row)

dated Simla, 23 May 1929 (Appendix 1).

APPOINTMENT OF PRINCIPAL OFFICERS OF ICAR

Diwan Bahadur Sir T. Vijaya Raghavacharya, an officer of the Madras Provincial Service, who had served as Director of Fisheries, Madras, and was serving as member of the Public Serviee Commission, was appointed as Vice-Chairman, Imperial Council of Agricultural Research. Mr M. S. A. Hydari, ICS, was appointed as Secretary and Mr Bryce Burt as the Agricultural Expert.

FIRST MEMBERS OF THE GOVERNING BODY

The Governing Body of the Imperial Council of Agricultural Research included 16 persons as its first members. This was a much smaller number than that recommended by the Commission, but ensured a more compact body. The President was Khan Bahadur Sir Mohammed Habibullah, Member of the Executive Council of the Governor-General in charge of Education, Health and Lands. It included nine representatives of the Provinces, of whom six were Ministers, viz. Mr Setu Ratanam Ayyar (Madras), Mr Baskar Rao V. Jadhav (Bombay), Sir A. Ghuznavi (Bengali), Maharaj Kumar Mahajit Singh (United Provinces), Sir Jogendra Singh (Punjab), Sir Lee Ah Yain (Burma) and Sir Sayid Mohammad Fakhruddin Khan Bahadur (Bihar and Orissa). Sir Arthur Edward Nelson, Member in charge of the portfolio of Agriculture, Central Provinces and Berar, and Sir Egbert Laurie Lucas Hammond, Member in charge of the portfolio of Agriculture, Assam, were other two members. It further included three MLAs, viz. Mr V. Ramdas Pantulu, Member, Council of State, Madras, Mian Mohammad Shah Nawaz, Member, Legislative Assembly, Lahore, and Chaudhry Mukhtar Singh, Member, Legislative Assembly, United Provinces. Besides, there were two members who represented commercial interests, viz. Sir Joseph Kay, representative of the Associated Chamber of Commerce of India and Ceylon, and Mr Walchand Hirachand, Representative of the Federation of Indian Chamber of Commerce and Industry, Bombay. The sixteenth member was Sir Frank Noyce, Officer on Special Duty, Department of Health, Education and Lands, who had processed the recommendations of the Commission.

CHAPTER 4

# REVIEW OF PRODUCTION OF CROPS IN INDIA

A Note by Dr W. Burns: 'Technological Possibilities of Agricultural Development in India'; 'A Memorandum on the Development of Agriculture and Animal Husbandry in India' by Sir Pheroze M. Kharegat'

1920-1944

THE food crisis created by the Second World War and the Bengal famine of 1943 were matters of great concern to the British Government. To meet the food shortage, a 'Grow More Food' campaign was initiated in 1943. Time had come to assess the results of that campaign. One conclusion was obvious that the administrative apparatus and field establishment of the departments could not adequately handle the development schemes. The district administration was pre-occupied with problems of law and order and regarded agricultural development schemes of secondary importance. While review of agricultural production in the past was necessary, it was also as important to assess the potential of future development with the application of then-known scientific techniques.

The Governing Body of the ICAR presided over by Sir Jogendra Singh directed Dr W. Burns, formerly Agricultural Commissioner, to prepare a note on the 'Technological Possibilities of Agricultural Development in India' and also to review the production of all major crops since 1920 to 1943, keeping in view the rise in population. He was asked to examine the *existing situation and to point* out what increases were possible with the adoption of scientific methods. In this task were associated with him the Directors of Agriculture of the provinces, and Director of Imperial Agricultural Research Institute, Dr B. P. Pal, Imperial Economic Botanist, Dr H. S. Pruthi, Imperial Entomologist, and Dr G. W. Padwick, Imperial Mycologist, and others.

Dr Burns concluded that season had overwhelming effect both on area and production. Fluctuations were most marked on crops which depend on rainfall, and there were very large gaps between production in the best and worst years because of rainfall. The areas under cash crops were also much affected by the prices prevailing in the previous year. A notable feature of the years 1929-30 to 1932-33,

the years of Great Depression, when prices of agricultural crops slumped, was that the slump had very little effect on production. In other countries with commercialized agriculture, slump in prices of crops had a marked effect on production. In India, however, at that time it was only a subsistence economy with little use of costly inputs like fertilizers and machinery. That is why farmers continued to produce crops to which they were accustomed to maintain themselves. Their income, not significant even before, was reduced by about half, with the result that there was distress among farmers.

Dr Burns also observed that population was increasing more rapidly than the production of food crops. This tendency was most marked in Madras province and least in the Central Provinces.

A graph was prepared to show the total area of all major foodgrains, viz. rice, wheat, barley, sorghum (*jowar*), maize and gram, and population increase. It indicated that while population was rising alarmingly, food production was going down (Fig. 3). This was the situation which the British Government was facing at that time and no doubt it contributed to the exit of the British from the Indian scene.

Analysing the 'Grow More Food' campaign of 1942 - 43, Dr Burns noted that the additional production of foodgrains was obtained by diversion of a substantial area from short-staple cotton to millets. This was owing to concessions and financial assistance offered by the Central and Provincial Governments and higher prices of foodgrains.

Dr Burns also examined the principal crops. After considering the average outturn obtained, he tried to assess the technological possibilities of these crops in the future in the light of the yields per acre, which research so far had shown to be possible through such means as using improved varieties of seed, application of manures and protection from pests and diseases.

He concluded that in rice there was a possibility of increasing the average outturn by 50%, viz. 10% by the use of a good variety and 40% by manuring. In wheat the average outturn was 720 kg/ha; however, an average yield of 1 350 kg/ha for irrigated wheat and 675 kg/ha; for rainfed (*barani*) were attainable. Dr Burns considered that an improvement of 20% was possible in *jowar* and 25% in *bajra*. About cotton it was not found possible to lay down any targets as the matter was one of national and international policy. In jute the average production of 1 315 kg/ha could be increased to 1 650 kg/ha, thus freeing about 303 000 ha for food crops. In tobacco he contemplated an ultimate area of cigarette tobacco of 80 800 ha and a production of

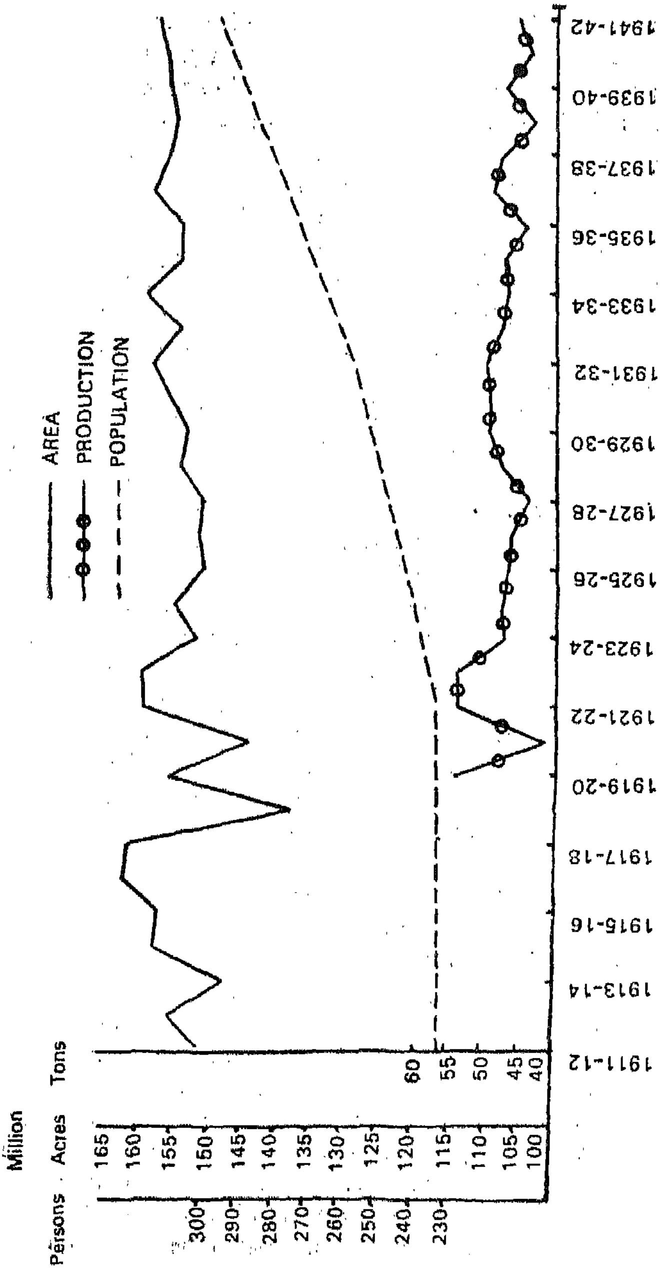



Fig. 3. Total area and production of major foodgrains (rice, wheat, barley, sorghum, pearlmillet, maize and gram) in British India

60.6 million kg of flue-cured tobacco.

In fruits and vegetables he concluded that the possibilities were enormous, but in the absence of statistics no targets could be fixed. In potato production could be doubled.

About general aims of agricultural development, Dr Burns held that two objectives must be kept in view, viz. the abolition of poverty of the cultivator and the abolition of the poverty of the soil, and manures should be utilized to their maximum capacity. He further pleaded for strengthening the extension wings of the provincial and State Departments of Agriculture. He proposed that the various lines of village improvement be linked up with and made part of agricultural development under one authority.

Dr Burns recommended the utilization of river water by pumping and construction of dams on rivers and *nallahs* and impounding water in areas near the hills.

For disease control he recommended development of resistant varieties of crops and the use of fungicides and insecticides. He felt that there was a large scope for the manufacture of fungicides, insecticides and sprayers in India. He also laid emphasis on the development of bullock-drawn implements.

Sir Pheroze Kharegat, Vice-Chairman of the Imperial Council of Agricultural Research, prepared a Memorandum on the Development of Agriculture and Animal Husbandry in India, which was considered by a committee in which, apart from the author, Mr H. R. Stewart, Agricultural Commissioner, Major Graham Williamson, Animal Husbandry Commissioner, Dr H. S. Pruthi, Director, Imperial Agricultural Research Institute, Dr F. C. Minett, Director, Imperial Veterinary Research Institute, Izatnagar, and Khan Bahadur M. Afzal Husain participated.

In this Memorandum recommendations were made on all aspects of agriculture, viz. crops, soil reclamation, irrigation, manures, seeds, implements, etc. It also recommended organization of a Federal Agricultural Research Institute and a number of Commodity Research Stations. Precise recommendations were made in respect of each. In all, an annual expenditure of Rs 250 million on the development of agriculture and animal husbandry in India was envisaged. Though many of these recommendations never saw the light of the day, some of them were made use of in the planning process which followed subsequently.

CHAPTER 5

# THE COMMODITY COMMITTEES

## Phase I. 1921-1941

APART from the Indian Council of Agricultural Research, there were a number of Commodity Committees which dealt with research in respect of particular crops. These Commodity Committees were semi-autonomous bodies financed by grants from the Government of India, or by income from cesses, and were located in the main growing regions of the crops concerned. The earliest Commodity Committee to be organized was the Indian Central Cotton Committee which was established in 1921.

### INDIAN CENTRAL COTTON COMMITTEE (1921)

The Indian Central Cotton Committee was established by the Government of India in 1921, following the recommendation of the Indian Cotton Committee of 1917-18. For the first two years the Committee functioned in a purely advisory capacity, helping the Government in securing co-ordination in matters relating to cotton. In 1923, however, the Committee was incorporated under the Indian Cotton Cess Act and was provided with separate funds to undertake work on cotton improvement. Later the Act was amended in 1948 for including in the functions of the Committee the development of improved methods of growing, manufacturing and marketing of cotton.

The Vice-President of the ICAR was the *ex-officio* President of the Committee. The Committee had a full-time Secretary as the chief executive officer who was assisted by a Deputy Secretary and an Assistant Secretary.

Mr V. A. Grantham (1921-1924), an industrialist, was the first Vice-President of the Committee. He was followed by Mr J. A. Kag (1924-1926), Mr Ellis Jones (1926-1928), and Mr S. D. Saklatvala (1928-1930). Sir Purushotamdas Thakurdas was Vice-President from 1932 to 1937. He was followed by Sir Chunilal V. Mehta (1938-1946). Mr R. G. Saraiya was Vice-President from 1947 to 1952. Mr Chiman Lal B. Parikh was Vice-President from 1953 to 1958. The last Vice-President of the Committee was Mr Madan Mohan Ruia (1959-1963).

Mr Bryce C. Burt was the Secretary of the Committee from 1921 to 1928. He was followed by Mr J. H. Ritchie (1928-1932), Mr

P. H. Rama Reddy (1932-1937), Mr D. N. Mehta (1939-1947), Mr C. J. Bocarro (1947-1948), Mr Kalidas Sawhney (1948-1953), Mr P. D. Nair (1953-1955) and Dr B. L. Sethi (1956-1963).

The Committee had on its general body representatives of cotton growers, agricultural departments, the cotton trade, the textile industry, the co-operative banks and the cotton ginning, pressing and manufacturing industries. The Committee provided a forum for the discussion of many problems affecting both cotton production and the cotton trade. The Committee's primary concern, however, was the interest and welfare of the cotton growers.

### Sources of Finance

The Indian Cotton Cess Act of 1923 provided for a compulsory levy of a cess of 2 annas (4 annas for the first three years) per standard bale of Indian cotton either exported from the country or consumed in the mills in India. By the Indian Cotton Cess (Amendment) Act, 1947, the cess was made applicable to imported cotton also. By a further amendment of the Act in 1948, the cess of 2 annas per bale was raised to 4 annas per bale. Further, from 1 April 1951 the provisions of the Indian Cotton Cess Act were extended to all the States. Besides the income from this cess, the Committee received from time to time special grants from the Government of India's Cotton Fund, which was built up from the proceeds of the import duty on raw cotton imposed by the Cotton Fund Ordinance (VIII of 1942).

### Pattern of Financial Assistance

Until 1937 the entire expenditure on the various schemes was borne by the Committee, but in view of the gradual depletion of its reserve funds it was decided that the State Governments should accept increasing responsibility for the schemes financed by the Committee, which at the end of their sanctioned period were expected to produce beneficial results.

The Committee financed research schemes in full up to 10 years and on a 50:50 basis for the next five years. After such schemes had been in operation for 15 years, the Committee's contribution was stopped altogether and they were transferred completely to the State Government concerned.

### Schemes of the Committee

The investigations financed by the Committee were botanical schemes for breeding high-yielding superior types of cotton, entomo-

logical schemes for the study of life-histories of important cotton pests and measures to control them, mycological schemes for finding ways and means of preventing losses due to fungus infestation, physiological schemes for the study of crop growth, agronomical schemes for determining the manurial and other requirements of the crop, and statistical schemes for the study of the various factors that contribute to the collection and interpretation of statistical data on cotton.

As a result of the research work relating to cotton improvement, 70 improved varieties of cotton had been evolved since the inception of the Committee. These had been bred in successive years, and the staple quality of the Indian cotton had been considerably improved.

## INDIAN LAC CESS COMMITTEE (1931)

The organization that later grew into the Indian Lac Cess Committee had its origin in the Lindsay-Harlow Report of 1921. The need for this enquiry arose on account of the importance which shellac had assumed during the First World War in the manufacture of gramophone records and electrical goods, as also in many of the requirements of the armed forces. The end of the First World War brought in its wake wide fluctuations in prices, which exposed shellac to serious competition from other substitutes.

In 1921 the Government of India deputed Mr H. A. F. Lindsay, ICS, and Mr C. M. Harlow, IFS, to conduct an enquiry into the different aspects of lac production. They stressed that scientific research should be conducted on the life-histories of the lac insect and its enemies, as well as on the chemistry of lac. It was suggested that this research should be undertaken by the Lac Association for Research at Calcutta and the consequent expenditure met by the levy of cess. And this association, in addition to research, should publish crop forecasts and undertake propaganda work in foreign countries.

As a result, the Lac Association for Research was organized in 1921 and necessary funds were placed at its disposal by imposing a small cess of 4 annas per maund (37.35 kg) on all lac other than refuse lac, and of 2 annas per maund on refuse lac. This Association subsequently decided to establish the Indian Lac Research Institute at Namkum (Ranchi).

The Royal Commission on Agriculture in India (1927-28) considered that the membership of the Association had been limited to the bigger merchants who could not be expected to take sufficient interest in the improvement of the lot of the cultivator. The Commission

therefore suggested that the Government should have its nominees in the Association to watch the interests of the cultivators, and that it should also have some control over matters of policy.

This recommendation was accepted, and by a statutory enactment the Indian Lac Cess Committee came into being in 1931. Opportunity was also taken to enlarge the functions of this Association to include the investigation of marketing methods and sales promotion. At the same time, the cess was raised to 7 annas per maund on all lac other than refuse lac, and to 5 annas per maund on refuse lac.

ORGANIZATION

The Committee was originally a single body, consisting of 17 members. The Vice-Chairman of the Imperial (now Indian) Council of Agricultural Research was its *ex-officio* President. The other *ex-officio* members were the Inspector-General of Forests, the Forest Entomologist, the Conservators of Forests, Bihar and Orissa, the Directors of Agriculture, Bihar and Orissa, and the Director of the Indian Lac Research Institute. The representatives of the trade included three manufacturers from the manufacturing industry, one representative of the export trade, one representative of the brokers and five representatives of the cultivators (mostly government officials).

An amending Act was passed in 1936. It effected a major change in the constitution of the Committee in that the Committee was bifurcated into a Governing Body and an Advisory Board. According to this amendment the Advisory Board consisted of 11 members, including the Chairman, two chemists, two entomologists, two forest officers, the Director of Agriculture, Bihar, the Director, Indian Lac Research Institute, and two experts—one representing the lac manufacturing industry and the other the lac-consuming interests.

The annual income of the Committee was approximately Rs 0.7 million, bulk of which was spent on research and extension schemes. The Committee had its Lac Research Institute at Namkum, about 9.5 km from Ranchi.

The Vice-President of the ICAR was the President from 1931 to 1939 and after that the Agricultural Commissioner was the President. Rai Bahadur L. Sen was its Secretary from 1931 to 1939 and Mr Pritam Singh from 1957 to 1963.

INDIAN CENTRAL JUTE COMMITTEE (1936)

The Royal Commission on Agriculture recommended the formation of a Central Jute Committee on the lines of the Indian Central

Cotton Committee to deal with all problems relating to jute, its cultivation, technology and marketing. This recommendation was accepted by the Government of India, and the Indian Central Jute Committee was set up in May 1936 with its headquarters at Calcutta (Bengal), the main jute-growing State of India. The Committee was constituted on the basis of equality of representation between the growers and manufacturers with the Vice-Chairman (now Vice-President), Indian Council of Agricultural Research, as the *ex-officio* President of the Committee.

The objects of the Committee were to undertake, assist or make, in connection with the jute industry in India, agricultural technological and economic research and propaganda, improvements in crop forecasting and statistics, production, testing and distribution of improved seeds, enquiries and recommendations relating to banking, storage and transport facilities and transport routes, and improvements in marketing; to advise the Central and State Governments concerned on any point referred to it, provided the subject-matter of reference falls within the prescribed functions of he Committee; and to collect and distribute to those connected with the jute industry in India whatever information and statistics becomes available that may assist the various interests concerned.

Consequent on the partition of India, the Government of India decided that the Indian Central Jute Committee should continue to function as in the past within the Indian Union under the administrative control of the Government of India. Accordingly, necessary amendments were made to the then existing rules and regulations of the Committee, and the affairs of the Committee in Pakistan were wound up. The scope of research of the Committee was widened to include research on allied fibres also, viz. mesta, *sisal*, hemp, sannhemp, ramie, etc.

### FINANCE

At the time of setting-up the Indian Central Jute Committee, the Government of India decided to finance the Committee with grants from Central Revenues to the extent of Rs 0.5 million a year. The position was to be reviewed after 5 years or earlier if necessary. In 1936-37, a grant of Rs 0.2 million was sanctioned for the Committee. After the partition of the country, the Government of India increased the annual grant-in-aid to Rs 1 million with effect from the financial year 1948-49.

Under the Second Five-Year Plan, the Government of India provided the Committee with (*i*) Rs 2.5 million for Central as well as State Government research schemes on jute, and (*ii*) Rs 0.93 million for strengthening the Technological Research Laboratories and for some construction works of the Jute Agricultural Research Institute.

The Government of India made available to the Committee Rs 7 million for new schemes to be undertaken under the Third Five-Year Plan.

The first Vice-President of the Committee was Mr H. S. Burn (1938-1939). He was followed by Mr P. S. Macdonald (1939-1940), Mr W. A. H. Walker (1940-1943), Mr I. G. Kennedy (1944-1951), Mr K. D. Jalan (1953-1955) and Mr J. G. Walton (1955-1960). The last Vice-President was Mr B. P. Kedia (1961-1964).

The first Secretary was Mr A. I. Cliff (1936-1939). He was followed by Mr D. L. Mazumdar (1939-1943), Mr B. Das Gupta (1943-1945), Mr G. C. Sen (1945-1948), Mr J. V. Lakhani (1948-1951) and Mr K. N. Agha (1951-1960). The last Secretary was Mr B. N. Sinha (1960-1964).

CHAPTER 6

# THE COMMODITY COMMITTEES

Phase II. 1944 to 1958

## INDIAN CENTRAL SUGARCANE COMMITTEE (1944)

THE Indian Central Sugarcane Committee was constituted by the Government of India in November 1944, as a body corporate, and was registered to undertake improvement and development of sugarcane, jaggery (*gur*), sugar and other by-products. On the formation of the Development Council for Sugar Industry under the Industries Development and Regulation Act, 1951, the Government of India in the Ministry of Food and Agriculture reconstituted the Indin Central Sugarcane Committee, divesting it of the functions relating to the technology of sugarcane but entrusting it with research and development of sugarcane and *gur*. The development of *gur* has been entrusted to the All-India Village Industries and Khadi Commission. The headquarters of the Committee were located at New Delhi.

The technical programmes of all sugarcane research investigations and development work in the country were scrutinized and approved by the Committee. The Government of India contributed to the Committee for its activities an annual grant of Rs 0.8 million besides providing funds for approved schemes.

### RESEARCH SCHEMES

The Committee spent its funds on the research schemes on sugarcane, *gur* and *khandsari*. It also organized Crop Competition schemes on sugarcane. There were also schemes for assessing the cost of cultivation of sugarcane in important States.

The Indian Central Sugarcane Committee subsidized the research schemes on a 50 : 50 basis of pay and all allowances of the staff in the states, and met the full expenditure on the schemes under the central institutes, such as the Sugarcane Breeding Institute, Coimbatore, Indian Institute of Sugarcane Research, Lucknow, Indian Agricultural Research Institute, New Delhi, etc.

Mr Dip Narayan Sinha was the President of the Committee from 1948 to 1950 and again from 1950 to 1954. After that, Joint Secretaries in the Ministry of Food, Government of India, were made President of this Committee. S. Lal Singh was its Vice-President from 1952 to 1961. Mr R. D. Bose was its Secretary from 1948 to 1955 and

Mr P. P. Chandra from 1955 to 1961.

INDIAN CENTRAL COCONUT COMMITTEE (1945)

Before the First World War, India had been exporting fairly appreciable quantities of copra and coconut oil to foreign countries. But the conditions created by the war and the fillip it gave to the vegetable oil industry and the soap and toilet goods industries in India made it necessary for the country to import large quantities of copra and coconut oil to meet its needs. The occupation of some of the principal coconut-growing countries in the East, viz. the Philippines, Indonesia and Japan, during the Second World War caused an acute shortage in the supply of copra and coconut oil in India. This situation necessitated steps to intensify the production of coconut so as to make the country self-sufficient in the commodity. The Government of India, therefore, decided to set up an all-India organization to take steps for the development of the coconut industry in all its aspects and also watch the interests of coconut growers. Accordingly, the Indian Coconut Committee Act was passed by the Central Legislature in 1944, and the Indian Central Coconut Committee came into existence in February 1945, with its headquarters at Ernakulam in Kerala State.

The functions of the Committee fell under four main heads: (*i*) undertaking, assisting or encouraging agricultural, industrial and economical research; (*ii*) improving the marketing of coconuts and coconut products ; (*iii*) supplying information regarding the coconut industry to the general public, giving technical advice to the growers and carrying on propaganda in the interests of the coconut industry; and (*iv*) tendering advice to the Central Government in respect of policy matters connected with the development and improvement of the coconut industry.

COCONUT IMPROVEMENT FUND

The Indian Coconut Committee Act provided for the creation of a fund called the Coconut Improvement Fund, which was to be expended by the Committee in the discharge of its functions. A cess at the rate of 49 p/q of copra (indigenous and imported) crushed in all the power-operated mills was collected by the Central Excise Department and paid by the Government of India to the Committee on a quarterly basis. Before 1 April 1953 the cess used to be collected only from mills coming under the purview of the Indian Factories Act. From this date, however, the cess had been collected from all power mills

by virtue of the Indian Coconut Committee (Amendment) Act, 1952. The average annual income from the cess for the 5 years ending 1959-60 was Rs 0.84 million.

The Committee had a Central Coconut Research Station at Kayangulam and another at Kasaragod. The research station at Kayangulam dealt with investigation and control of the stem-bleeding diseases and pests, whereas that at Kasaragod dealt with selection, breeding and hybridization and research on agronomy.

The Vice-President of the ICAR was the President of the Committee. Rao Sahib A.K. Menon was the Vice-President from 1947 to 1948 and Mr K. P. Madhavan Nair from 1952 to 1961. Mr K. Gopalan was the Secretary from 1946 to 1955 and Dr P. J. Gregory from 1956 to 1961.

## INDIAN CENTRAL TOBACCO COMMITTEE (1945)

Tobacco is an important commerical crop in Andhra Pradesh, Gujarat and Mysore. Realizing the importance of tobacco in the nation's economy, in April 1943 the Government of India imposed an excise duty on the various types of tobaccos at different rates, and from the proceeds set apart a grant of Rs 1 000 000 for the improvement of tobacco in the country. The Indian (then Imperial) Council of Agricultural Research administered the grant until the Indian Central Tobacco Committee was constituted in 1945 and took over the previous schemes. The headquarters of the Committee was at Madras.

### SOURCE OF REVENUE

The Committee received from the Central Government a non-lapsable annual grant of Rs 1.75 million for administration and for financing schemes of research and marketing and other developmental activities. The Committee was also given a special grant for financing schemes under the Third Five-Year Plan.

### FUNCTIONS

The functions of the Indian Central Tobacco Committee were to assist in various possible ways in the improvement and development of production and marketing of different kinds of tobacco and their products in the country. This required the Committee to undertake, assist and encourage agricultural, industrial, technological and economical research.

The Committee's aid was ordinarily limited for 10 years for agricultural research schemes, 5 years for developmental, marketing and

seed multiplication schemes and 3 years for schemes of technological nature. The schemes were subject to review at the end of the third, fifth and eighth years.

The Committee established its own Central Tobacco Research Institute at Rajahmundry in Andhra Pradesh. Besides, it had eight substations in the States, viz. Cigarette Tobacco Research Substation, Guntur (Andhra Pradesh); Cigar and Cheroot Tobacco Research Station, Vedasandur (Tamil Nadu); Hookah and Chewing Tobacco Research Station, Pusa (Bihar); Wrapper and Hookah Tobacco Research Station, Dinhata (West Bengal); Bidi Tobacco Research Scheme, Anand (Gujarat); Tobacco Research Station, Hunsur (Karnataka); Hookah Tobacco Research Substation, Ferozepur (Punjab); and Bidi Tobacco Research Substation, Nipani (Karnataka).

The Vice-President of the ICAR was the President of this Committee from 1946 to 1957 and from 1957 to 1964; the Agricultural Commissioner was the President. Mr A. M. Parikh was the Vice-President from 1946 to 1951. Mr C. Subramaniam was the Vice-President from 1951 to 1953; Mr K. Raghuramaiah from 1955 to 1957; Mr M.A. Parikh from 1957 to 1960; and Mr T. Venkatappaiah fiom 1961 to 1964. Mr T. S. Krishnamurti was its Secretary from 1946 to 1949; Dr M. S. Patel from 1951 to 1961 and Mr K. C. Chetty from 1962 to 1965.

## INDIAN CENTRAL OILSEEDS COMMITTEE (1947)

The Indian Central Oilseeds Committee was constituted in May 1947, under the Indian Oilseeds Committee Act, No. IX of 1946. The Committee had its headquarters at Hyderabad, the capital of Andhra Pradesh, which is the main castor- and groundnut-growing area. The Committee was financed out of the funds derived from an excise duty of 17 p/q on all oils extracted from oilseeds in any power mill in India, and a custom duty of 33 p/q on all oilseeds exported from India. These funds enabled the Committee to undertake improvement and development of the cultivation and marketing of oilseeds and of the production, manufacture and marketing of oilseed products in India.

The Committee represented various interests such as the Central Government, the State Departments of Agriculture, oilseed growers, consumers, co-operative societies, Oil Technologists Association, the village oil industry, the vegetable oil (*vanaspati*) industry, the power oil-crushing industry, exporters of oils and their products, oilseeds trade associations, the Federation of Indian Chambers of Commerce and Industry and the Federation of Rural Peoples Organizations. The total membership of the Committee was 61.

Under Section 7 of the Indian Oilseeds Committee Act, 1946, the Central Government may appoint persons to be the President and the Secretary of the Committee. The Vice-President was elected by the Committee every year.

Mr N. G. Ranga was the Vice-President from 1948 to 1952, Mr Ratilal M. Gandhi from 1954 to 1958, and again from 1961 to 1962 Mr H. Sitaraman Reddy was the Vice-President from 1958 to 1961, Mr Maddi Sudarshanam from 1962 to 1963 and Mr G. U. Rao from 1963 to 1964.

### Finance

The total receipts of the Committee since its inception in 1947 up to 31 March 1960 amounted to Rs 23 909 305, out of which Rs 21 466 720 represent the collections from the cess under Section 3 (2) of the Indian Oilseeds Committee Act, 1946. The receipts of the cess from oils and oilseeds during 1959-60 amounted to Rs 1 956 000 compared with Rs 2 289 346.50 in the previous year.

### Pattern of Financial Assistance

Agricultural research schemes were financed in full up to 10 years, subject to review at the end of the third, fifth and eighth years; for the subsequent 5 years the expenditure was shared with the State Government concerned on a 50 : 50 basis. After such schemes had been in operation for 15 years, the Committee's contributions were stopped altogether and the schemes completely taken over by the State Government.

## INDIAN CENTRAL ARECANUT COMMITTEE (1949)

The arecanut growers of India faced considerable hardship at the end of the Second World War due to the large-scale imports of the commodity into the country. Therefore the excise duty of 2 annas on every pound (453 g) of arecanut produced in the country, imposed by the Government of India in 1944, led the growers to organize themselves against this imposition. A conference of all interests connected with the industry was called in 1945 and the Government of India was urged to abolish the excise duty on arecanut, impose duty on imported betelnuts, set up a marketing board for fixing prices and licensing imports, and provide for researches on arecanut and its by-products. The Central Board of Revenue, after carefully considering the resolutions of the conference, directed a marketing survey of the arecanut industry under the supervision of the Agricultural Marketing Adviser to the Gov-

ernment of India. Acting on his recommendation, the Government of India decided to make an annual grant of not exceeding Rs 0.5 million to the ICAR for financing measures for improving, developing and marketing of arecanut in the country. Also, an *ad-hoc* Arecanut Committee was set up under the chairmanship of the Vice-President of the ICAR. The *ad-hoc* Committee, which met at Delhi in November 1947, recommended that a Central Arecanut Committee should be set up on the lines of the other Central Commodity Committees. Accordingly, in May 1949 the Ministry of Food and Agriculture constituted the Indian Central Arecanut Committee with an annual grant of Rs 0.5 million. The headquarters of the Committee was established at Calicut in Kerala State.

FUNCTIONS

The Committee assisted the Government in the improvement and development of the production and marketing of arecanut and arecanut products. It promoted research on arecanut palm. Seeds of improved varieties were distributed among growers, who were encouraged to adopt improved methods of cultivation. They were also assisted in the control of insect pests and diseases. Adoption of improved measures for the marketing of arecanut were also promoted. Statistics were collected from growers, traders and manufacturers on all relevant matters connected with arecanut. The Committee also recommended the fixation of maximum and minimum prices for the commodity.

FINANCE

The funds of the Committee were derived from the annual grant to the extent of expenditure, but not exceeding Rs 0.5 million, made by the Government of India for the normal activities of the Committee.

PATTERN OF ASSISTANCE

The research schemes were usually financed up to 10 years. Ordinarily the Committee met 50% of the recurring expenditure.

The Committee had an Arecanut Research Station at Vittal, in South Kanara District of Karnataka.

Mr K. Madhava Menon was Vice-President from 1949 to 1951, Mr Ramakrishna Mallya from 1951 to 1952, Mr M. N. Chouta from 1952 to 1954, Mr K. G. Wodeyar from 1954 to 1955, Mr A. M. Thomas from 1955 to 1957, Mr U. Subraya Mallia from 1957 to 1960, Mr C. M. John from 1960 to 1963 and Mr A. B. Bhat from 1963 to 1965. Mr K. K. Nambiar was its Secretary from 1949 to 1955 and Mr B. S.

Varadarajan from 1957 to 1962.

INDIAN CENTRAL SPICES AND CASHEWNUT COMMITTEE (1958)

Spices and cashewnut are important foreign-exchange-earning commodities and the question of establishing an organization for their improvement and development had been engaging the attention of the Government of India for a number of years. Recommendations to this effect were made at the First Spices and Cashewnut Seminar held in May 1958, at Mercara, Coorg; at a conference on Marketing of Spices, Cashewnut and Arecanut held at Trivandrum, (Kerala) in November 1958; and at the meeting of the Governing Body of the Indian Council of Agricultural Research held in December 1958. It was felt that though considerable progress had been made in the matter of research and development, the marketing of these crops had not been developed effectively. The result was that the grower continued to suffer from serious market fluctuations and declining prices. This led to repeated representations from the growers and traders for the formation of a separate organization to deal with all the problems connected with these crops.

In the interest of an all-round development of spices and cashewnut, the Government of India decided to set up an Indian Central Spices and Cashewnut Committee under the aegis of the ICAR. A grant of Rs 1 million annually was placed at the disposal of the Council for the purpose of the Committee. The Committee dealt with all aspects of research, development and marketing of these crops, and coordinate these several activities in an effective manner.

The Committee dealt with pepper, cardamom, ginger, turmeric, cinnamon, clove, nutmeg, mace, vanilla, cashewnut, chillies, celery, cumin (*zira*), coriander, fennel and fenugreek.

The Vice-President of the ICAR, Mr A.D. Pandit, was its President from 1963 to 1964. Mr P. B. Kurup was its Vice-President from 1963 to 1965 and Mr E. K. Balasundram was its Secretary from 1963 to 1965.

With the organization of a series of commodity committees, the field of the ICAR came to be limited to food crops such as wheat, rice, barley, maize, millets, pulses, tuber crops, grasses and fodder crops, spices, horticulture and problems common to various commodities such as control of plant diseases and pests, manurial trials, improved implements and dry farming in the field of agriculture, and investigation and control of animal diseases, animal nutrition, animal breeding and dairying in the field of animal husbandry.

CHAPTER 7

# ICAR PUBLICATIONS

## I. Books and Monographs

NEED of scientific literature suited to the conditions prevalent in the country had been felt for a long time, particularly in agriculture, botany and zoology. In text-books relating to these subjects, type specimens were often foreign, whereas the plants and animals common in this country were not mentioned at all.

In 1955 when I joined as Vice-President of the ICAR, opportunity came for initiating an ambitious programme of publications in agriculture and botany. A minor incident sparked the programme. A delegation of Russian scientists came to the ICAR building to meet me. Question arose as to what book should be presented to them. When I enquired what book was available, the Secretary brought Col. R. N. Chopra's *Poisonous Plants of India.* I felt it was not a suitable present for a delegation from a friendly country. Next day I discovered that a manuscript of a book on *Mango* by Ranjit Singh and S. L. Katyal with many illustrations in colour was available and could be sent to the press. Government of India publications were drab and poorly printed. This was due to the fact that on account of tender system the press which gave the lowest quotation was given the printing work. This worked to the disadvantage of quality presses, whose cost of production was higher. This problem had to be solved. I got prepared a list of all the worthwhile presses in India and classified them in three categories. In the first category were presses which did quality work, particularly in colour printing. The second category included presses which had good types but had not specialized in colour printing. In the third category were the presses which were doing printing work of average quality. When a book contained a number of colour illustrations, quotations from the first-category presses alone were invited. This ensured quality printing, as competition was only among the best presses of India.

Production of books cannot be left to presses alone, for a lot of preliminary work is necessary, such as providing illustrations, lay-out and editing. This meant re-organization of the entire set up and setting up of a Publications Directorate with editorial staff, and art and photography sections. While artists were necessary for designing title covers and for preparing illustrations in black and white, I felt it was necessary to have a

library of photographs. I employed a very competent artist-photographer, Mr H. K. Gorkha, who was my companion in my travels all over India, particularly in the southern States which have much interesting patterns in agriculture. During these tours I guided the photographer in the choice of subjects. Fields, villages, houses, crops, forests, garden plants, domestic animals and typical farmers both men and women were photographed. Thus a comprehensive library of 10 000 negatives was built up, which provided material for illustrating books and monographs.

Next came the choice of authors and assignment of subjects. I found there was no lack of capable men among our scientists in the nationals and state research institutes, who were interested in some subjects. An opportunity was given to them to write on the subjects in which they were deeply interested. There are many good scientists, but there are few who can express themselves clearly and concisely. To overcome this problem, I was fortunate in selecting a man as an editor who was not a scientist but had good knowledge of English language and had a penchant for editing. He knew the intricacies of punctuation, capitalization, spellings, etc. Botanical names of plants which are changed from time to time on the rule of precedence also presented a problem. For this an editor was appointed who had good knowledge of systematic botany.

The subject which attracted my immediate attention was of cereal crops, which on account of food shortages that plagued the country deserved prior consideration. An international seminar on rice sponsored by the FAO was to be held in October 1956. Mr R.L.M. Ghose, Director of the Central Rice Research Institute, Cuttack, and his colleagues had collected material on the history, morphology, breeding and diseases of rice. This was quickly edited and given the title of *Rice in India* and printed in September 1956. This was thus the first book published in the publication programme initiated by me.

Horticulture, particularly the much ignored ornamental plants, drew my attention next. After the publication of the monograph on *Mango* in 1957, I called a meeting at which leading horticulturists and gardeners were invited. Books on gardening contained long lists of names of plants, which included trees, shrubs and climbers, and their brief descriptions. Nature has endowed our country with a variety in climate that enables us to grow all types of plants from the arctic to the tropical. I felt there was need of separate books on flowering and ornamental trees, shrubs, climbers and annuals in which, apart from

detailed description, hints on cultivation and plant protection should also be given. I accepted the assignment for a book on *Flowering Trees*, which was published in 1957. It set a new standard in science publications and was admired by a large number of people, including Sir C.V. Raman, who had passion for colour. This book served as a guide for other authors, and was briskly sold. This assured the Financial Advisor of the ICAR that there was no financial risk involved in this publication programme to which substantial funds were committed. In fact, it showed that a well-written book with sound information, if produced in an attractive manner, is no financial risk and could be a profitable investment.

Dr B. P. Pal, apart from being an outstanding wheat breeder, is also a lover of plants. He wrote a number of books for publication in this programme, viz. *Beautiful Climbers* (1960), *Flowering Shrubs* (1967), *The Rose in India* (1966) and *Bougainvilleas* (1974).

The Commodity Committees of the Ministry of Food and Agriculture, of which I was the Chariman, were also brought within the ambit of this programme. They published monographs on *The Coconut Palm* (1956), *The Arecanut Palm* (1958), *Jute in India* (1959), *Indian Tobacco* (1960), *Cotton in India*, 4 Vols (1961), and on all oilseed crops.

Then I started a programme of publication of monographs in botany. Here I gave precedence to algae, a subject in which I was personally interested. A good deal of research on algae in India had been done by the late Dr M. O. P. Iyenger and myself, which resulted in the discovery of a number of new and interesting plants. Information regarding these new species of algae was scattered in a number of research journals, but teachers and students of botany were not familiar with them. I felt that all this knowledge must be presented in a series of monographs. I called a meeting of algologists from all over India in 1956 and drew a comprehensive programme of monographs. In this work Dr Iyenger gave me great co-operation and support. Monographs on *Volvocales* and *Siphonales* were assigned to him. I agreed to write a monograph on *Zygnemaceae*, in which I was assisted by a new-found industrious student, Mr G. S. Venkataraman. A monograph on *Cyanophyta* was assigned to Dr T. V. Desikachari. Both these monographs were published in 1959 and provided guidance to other assignees. Dr Iyenger was an over-cautious man who was never satisfied with his work and was constantly endeavouring for perfection. I sent an artist from the ICAR to ink his diagrams of algae. With all this assistance Dr Iyenger could not finalize the monographs in his life-time. After his death,

his devoted student Dr Desikachari completed these monographs.

In the production of these monographs, one problem was of the size of print order. We found that an edition of 1 000 was adequate for all-India and world sale. When print order exceeded 1 000, it was difficult to sell the surplus.

After the publication of a couple of monographs on algae, I called a meeting of the mycologists working in universities as well as in central research institutes and made a publication programme of monographs on fungi. This programme was pioneered by Dr K. S. Thind, whose *Clavariaceae of India* was published in 1962. It was followed by an excellent monograph on *Indian Hyphomycetes* by Dr C. V. Subramaniam.

Publication of monographs on botanical subjects was really the responsibility of the Council of Scientific and Industrial Research, which they had not owned so far. When Dr Hussain Zaheer became its Director-General, I found there was congenial atmosphere for initiating such a programme. A monograph on *Gnetum* written by Dr P. Maheshwari and Vimla Vasil was the first to be published in 1961. It was followed by four others.

All these monographs were favourably reviewed in science journals and were appreciated by teachers, research workers as well as students. They were helpful in research for they indicated the present frontiers of knowledge in respect of the subjects they covered. Some of the monographs related to Indian plants only and a few were on world basis. The latter won recognition in many universities in foreign countries and are still consulted. My object in initiating this programme of monographs was to provide material for a sound *Text Book of Botany*, in which most of the interesting types of plants found in India would be included. This still remains a dream. Now there is need of a man who could synthesize all this knowledge and present it in the form of a tex-book, which would be relevant to the flora of India

As I see, it was not at all a smooth sailing, When the programme of production of books on agriculture was started, it was opposed by Mr Malcolm Orchard, an American Advisor on Extension Literature attached to the ICAR, who was supported by some members of the ICAR staff. He was of the view that the ICAR should produce only farm bulletins, and not books. Farm bulletins produced by the ICAR had application only to limited areas. Considering the size and diversity of the country and the agro-climatic conditions prevailing in the different States, only the State Governments could take up production of farm

bulletins suited to their own conditions. This is the work which the Extension Directorates of the agricultural universities have taken up now in right earnest. My feeling was that both the books on agriculture as well as farm bulletins were necessary and each had its own place in the agriculture of the country. Ultimately, it was decided that farm bulletins can continue but the books must also be produced. After this, a massive publication programme, which included monographs on algae, fungi, and principal crops of India, reference books, technical books, text-books and popular books, handbooks and manuals was started in right earnest. Up to 1956 hardly one or two books per annum were published by the ICAR. From 1957 onwards the number increased. In 1959 nine books were published; in 1960, 13; in 1961, nine; and in 1962, 14. Now on an average 20-30 books, bulletins and other publications are brought out every year.

When I look back, I feel a sense of satisfaction that a correct decision was taken. The ICAR is now the biggest publisher of books on agriculture, horticulture and related subjects. Financially also, the programme of publications proved a success. It proved that if a book is written by a recognized authority on the subject and is well-produced, it sells.

CHAPTER 8

# ICAR PUBLICATIONS

## II. Journals

THE predecessors of the ICAR journals were the *Agricultural Journal of India* and the *Memoirs of the Department of Agriculture in India*, published by the Imperial Agricultural Research Institute, Pusa, since 1906. The Inspector-General of Agriculture was the Editor and was assisted by an Advisory Committee consisting of the staff of the IARI. The Journal dealt with subjects connected with field and garden crops, economic plants and fruits, soils, manures, methods of cultivation, irrigation, climatic conditions, insect pests, fungus diseases, co-operative credit, management of farm stock, cattle-breeding, cattle diseases, farm implements and the like. In the Memoirs, scientific work connected with agriculture including agricultural chemistry, economic botany, entomology, plant pathology and bacteriology found a place. Separate series were issued for the chief divisions of science concerned, and each article appeared as a separate memoir under the series into which it fell.

The Journal provided a permanent record under one cover, of the practical results of agricultural research work throughout India. It was also a medium of communication between the officers of the several departments, thus removing some of the isolation in which they worked. And it was hoped that it would also appeal to the leading agriculturists in India, who would be thus kept in touch with agricultural progress in the country, and would be able to test in practice the improved methods of cultivation and the application of science to agricultural problems, which the steady progress of knowledge of the plant life rendered increasingly available.

### EARLIER JOURNALS OF THE ICAR

In 1931 the ICAR started two new journals, one devoted to research in agriculture and the other to animal husbandry. Almost at the same time the Council renamed the *Agricultural Journal of India* as *Agriculture and Livestock in India*.

The journals, *The Indian Journal of Agricultural Science* and *The Indian Journal of Veterinary Science and Animal Husbandry*, were started to encourage exchange of ideas among workers engaged in research in different disciplines and to encourage investigations of econo-

mic value.

The journal *Agriculture and Livestock in India* included abstracts of research in agriculture as well as animal sciences. It continued to be published every two months for nine years. It was decided to give information in a non-technical, popular style in this journal. With this change in approach the journal was given the name *Indian Farming* in 1940. Mr F. M. de Mello, the Editor of this Journal, gave it a popular slant, but ensured quality in articles. The covers were however dull and unattractive, and get-up and printing poor. I remember I requested Sir Herbet Stewart, the Vice-President, in 1945 to agree to the change in the cover illustration, which showed a miserable dhoti-clad farmer driving a pair of bullocks yoked to a plough. He did not agree.

In 1945 Dr Usha Nath Chatterjee, a plant physiologist, joined as Editor. A new policy was adopted that *Indian Farming* should reflect the current problems of rural development and the aspirations of Indian farmers. I planned a special number of *Indian Farming*, viz. 'Developing Village India', which dealt with the problems of rural development. The Number was widely appreciated by the national leaders as well as others. Mr Devendra Satyarthi, the Assistant Editor, who is known for his collections of folk-songs of India, provided an excellent layout for this Number as well as artistic photographs from his personal collection. *Indian Farming* now looked distinctive among the drab Government publications.

After Independence, the need was felt for a journal in Hindi to promote scientific farming among the Indian farmers. As a result *Kheti* was born in 1948. Mr Devendra Satyarthi edited this journal and Mr D. N. Paliwal looked after its production.

Under the patronage of Mr K. M. Munshi, Minister of Agriculture, a new series of *Indian Farming* was started in 1951 and the Journal acquired an altogether new look. For this, credit is due to Dr U. N. Chatterjee the Editor. The size of the Journal was changed from crown quarto ($7\frac{1}{2}''$ x $10''$) to demy quarto ($9'' \times 11\frac{1}{2}''$). Good-quality art paper was used and it was profusely illustrated. The printing of the journal was taken out of the control of the Manager of Publications, Government of India, and arrangements were made for its printing at a private press. *Indian Farming*, which used to be several months in arrears, now started appearing on time and with an attractive get-up. Mr M. G. Kamath, who became Editor in 1954, further improved the Journal.

With the realization of the importance of statistics in agricultural research, a new journal, *Statistical Newsletter*, was started in 1951.

The publication of *Rice News Teller*, whose matter was provided by the Central Rice Research Institute, Cuttack, was taken over by the ICAR in 1953.

NEW JOURNALS OF THE ICAR

On my rejoining the ICAR as its Vice-President in 1955, I started a new quarterly, *Indian Horticulture*, in October 1956, to provide latest scientific information on fruit, flower and vegetable cultivation. Artistically produced, this Journal had an attractive four-page central colour plate printed on art paper. Mr Kamath was also the first editor of *Indian Horticulture* and planned its format, contents and other details. The Journal still carries some of the basic features introduced by him.

In 1959 I started two new journals, viz. the *Indian Journal of Agriculture and Veterinary Education* and the *Indian Potato Journal*. In the same year two new Editors joined the Council, viz. Dr P. Kachroo for research publications and Mr P. L. Jaiswal for semi-technical and popular publications. Dr Kachroo, who was Editor of Research Journals, initiated a quarterly journal, *Agricultural Research*, in 1961 to report on the current research activities of the research institutes of the Council. Mr Jaiswal started a new quarterly, *Indian Livestock*, in 1963 at the instance of Mr V. Shanker, the Vice-President. An attempt was made in this journal to explain technical material through histograms, sketches and pictures. The illustrated Journal was widely appreciated. Mr Jaiswal also introduced many new features in the popular journals such as 'Seasonal notes', 'Advances in farm research', 'News round-up', 'Readers' forum', 'Your problems', Cartoon strips, etc. These features became very popular. When Mr Jaiswal became Chief Editor he further improved these journals, which have since become more problem-oriented. Many special issues were brought out.

Publication programme in Hindi also received greater support. *Pashupalan*, a Hindi counterpart of the *Indian Livestock*, was brought out in 1963. The programme became more organized and broad-based with the joining of Dr R. G. Chaturvedi in 1964 as Editor (Hindi).

Dr B. P. Pal paid personal attention to research journals and raised their standard. A series of review articles by scientists of international repute were published in these journals. Refereeing of papers was made stringent, and editing was done carefully, conforming to international style and standard. As a result, there was great improvement in the quality of papers and their presentation. For the first time the research journals were printed on art paper. The journals received greater international recognition and the inflow of articles from foreign scien-

tists also increased.

AXEING THE JOURNALS

In 1966, the Government of India was experiencing financial stringency. They decided to reduce the number of journals published by the various Government Departments. As a result of the recommendations of the Cabinet Subcommittee constituted for the purpose, a number of journals issued by the Council and Commodity Committees were thoughtlessly discontinued or merged, ignoring the fact that they served special interests which required separate treatment. *Indian Livestock* was merged into *Indian Farming*, and *Pashupalan* in *Kheti*. *Statistical Newsletter* was transferred to the Institute of Agricultural Research Statistics. *Rice News Teller*, *Indian Potato Journal*, *Agricultural Research* and *The Indian Journal of Agricultural and Veterinary Education* were discontinued. This indeed was a retrograde step at a time when agricultural education and research were making great progress. The name of the *Indian Journal of Veterinary Science and Animal Husbandry* was changed to *The Indian Journal of Animal Sciences*. Thus only five journals, four in English and one in Hindi, survived the economy drive. To meet the great inflow of articles, the research journals were first converted from quarterly to bimonthly in 1967 and in 1969 to monthly.

From 1970 the emphasis in the Publications Programme shifted from voluminous monographs to smaller publications on crops and agricultural topics of importance. The programme was made need-based and problem-oriented. A large number of special numbers of *Indian Farming* and *Indian Horticulture* were brought out to focus attention on the current problems in agriculture.

A new agricultural digest, *Krishi Chayanika*, was started in 1973 to meet the increasing demand of high-quality scientific literature in Hindi. It publishes digest of important articles on agriculture in simple language.

Behind the success of the high standard of the ICAR publications was the support provided by the Art and Photography and Production Units of the Council. Mr N. S. Bisht, an experienced artist, who joined the Council in 1946 and retired recently, has left a mark on the publications brought out during his term. Credit for high production standard of the ICAR publications goes to Mr Krishan Kumar, the Production Chief of the Council. He is a leading specialist in his own field and has always been working with a great sence of dedication. Many printing awards have been won by him for the Council.

A brief account of the journals currently being issued by the ICAR is given below.

### The Indian Journal of Agricultural Sciences

*The Indian Journal of Agricultural Science* started as a bimonthly journal, became quarterly in 1948 and again bimonthly in 1967. In view of the great inflow of articles to this Journal, and for publishing the findings of latest researches in the shortest duration before the other researchers, massive volumes of 200-300 pages per issue were brought out in 1968-69, and ultimately the Journal was converted to a monthly in 1969.

The Journal maintained uniformity in its contents. In 1931 the matter was divided into Original articles, Abstracts, Notes and Book reviews. Since 1969, Research review articles written by eminent scientists in different disciplines were introduced. The articles were grouped more systematically and short research notes were grouped at the end. The name was changed to *The Indian Journal of Agricultural Sciences*.

In 1971, as a measure of economy, the layout of the Journal was changed to double column instead of single column used earlier. An abstract was included in the beginning of an article in place of the summary at the end.

Its earlier issues included a number of colour plates but since 1959 these were included only when necessary for showing scientific details. The Journal improved much in its get-up and editorial presentation. It is recognized by major international organizations connected with agricultural research publications. Mr S. N. Tata, a botanist with specialization in nomenclature of plants, is the Editor.

### The Indian Journal of Animal Sciences

*The Indian Journal of Animal Sciences* started as *The Indian Journal of Veterinary Science and Animal Husbandry*, which it incorporates since 1966. It is the topmost journal of its kind in the field of animal sciences. It deals with animal breeding, diseases, physiology, nutrition, dairying, animal production technology and fisheries. It was a quarterly till 1966, bimonthly during 1967 and 1968, and is a monthly since 1969. Mr R. R. Lokeshwar is the Editor of this Journal.

### Indian Farming

*Indian Farming* was meant principally for farmers and all those

interested in any branch of farming. The aim was to present scientific information in a popular form to the people interested in the application of science to the day-to-day problems of Indian agriculture and animal husbandry. In reality, 'it was a magazine for those interested in farming', not 'a farmers' magazine'. A new series of *Indian Farming* was therefore started in April 1951, written basically for the Indian farmer, the man who grows the crops and keeps the cattle. The size was changed from crown quarto ($7\frac{1}{2}'' \times 10''$) to demy quarto ($9'' \times 11''$). The contents included original articles. Its features were: 'What the scientists are doing, What would you like to know, The month's clip, New books and reviews, and Rag bag. Later on some new features were included: Man of the month, Research features, Women's page, Children's page, Questions and answers, Readers' forum, Advances in farm research, News in brief (research and development) and the Editorial page.

At present it has three basic sections, viz. Crop Sciences, Animal Sciences, and features, e.g. Symposia and Seminars, Advances in farm research and Book-shelf, besides an Editorial page.

An interesting and very useful feature is that of special supplements. These are brought out on current problems or topics relating to different crops, disciplines and institutes, either as an appended extra matter or as a full issue. Mr K. B. Nair is the Editor of the Journal.

INDIAN HORTICULTURE

To disseminate information on research developments in horticulture, the ICAR considered that readers in India needed a journal that would tell them about the new techniques of raising vegetables, fruits and flowers. It was also kept in view that this Journal would help the growers in comparing their experiences with those of the experts. Its main object was to bring to the gardener and the orchardist new techniques that would help them in giving the garden and orchard a new look and to improve production.

In addition to the articles written by eminent horticulturists, other features covered in the Journal are: News round-up, Gardening notes, What's new in horticulture, Readers' forum, Your gardening problems, etc. Many accent numbers were brought out on fruits and vegetables. Besides its attractive covers, this magazine included a central four-page colour plate, which was later discontinued in view of the high cost of printing. Still, with its useful, informative material it con-

tinues to be popular. Mr K. B. Nair is the Editor of this Journal also.

KHETI

This outstanding Hindi magazine in the field of agriculture and animal husbandry is a national magazine, which was started soon after Independence in 1948. Its object was to bridge the gulf between the scientist and the farmer, and between new discoveries and their application in field. As most of our farmers know only Hindi, *Kheti* brought out in Hindi is doing invaluable service in conveying the latest information on the farm front to them in a ready-to-adopt form.

*Kheti* was published in crown quarto size till April 1954; since then it is being brought out in demy-quarto size, in 2 columns, or occasionally in 3 columns. Its contents are divided under Editorial, News articles, Scientific experiments, Questions and answers, From States, From foreign countries, New books, News and views, and From research temples.

Though it started as a 'Hindi version of *Indian Farming*', it is now an independent publication, with original articles. Many special or accent issues of *Kheti* brought out from time to time proved popular. Since the incorporation of *Pashupalan* in it from 1966, it includes articles on animal husbandry as well as on crop sciences. Mr R. D. Sharma is the Editor of this journal.

All these journals continue to grow in popularity and also improve in quality. They present authentic and useful topical information, lucidly and in an interesting manner to scientists as well as the farmers.

CHAPTER 9

# AGRICULTURAL STATISTICS AND ECONOMICS

THE vital role of statistical science in agricultural research was recognized by the ICAR as early as 1930 when the Statistical Unit was created in the Council. This Unit, which later grew into the full-fledged Institute of Agricultural Research Statistics (IARS), has been doing pioneering work in the development of methodology for agricultural statistics. Apart from being responsible for the scrutiny, from the statistical point of view, of all technical programmes and progress reports of the Council's research schemes, the Institute undertakes projects for developing sampling techniques and experimental designs and extracts useful information from both experimental and observational data.

The Institute offers postgraduate training courses, catering to the needs of both agricultural research workers and professional statisticians. The latter courses include those leading to M.Sc. and Ph.D. degrees in Agricultural Statistics of the Postgraduate School of the IARI.

The Council has sponsored, over the last three decades, both at the Institute and elsewhere, research schemes for the development of improved techniques for collection of agricultural statistics. The principal achievements of the IARS are given below.

## STATISTICAL RESEARCH (CROP SCIENCES)

On the basis of uniformity trials on different crops, such as rice, wheat, cotton and vegetable crops, the optimum size and shape of plots and blocks and efficiencies of alternative experimental designs have been worked out. Methods have also been developed for studying the economics of manuring by the use of appropriate response curves on experimental data. Achievements in this field include designing of experiments on cultivators' fields and the developing of yardsticks of response to fertilizers and other inputs. Pre-harvest forecasting of the yield of important field crops is also undertaken.

The Institute has undertaken work on the national index of field experiments, which contains a unified record of experiments conducted in the country for the benefit of research scientists and administrators.

## STATISTICAL RESEARCH (ANIMAL SCIENCES)

In animal husbandry research, the introduction of ideas of modern

experimental design has been a slower process owing to certain inherent limitations of the experimental material, such as the maintenance of the experimental animals and the long duration of such experiments. Statisticians at the IARS have, however, done considerable work in standardizing the methods of sampling and measurements in connection with breeding, nutrition and their investigations. A sound progeny-testing programme for the improvement of cattle, a new method of sire evaluation more efficient than the traditional method, and the appropriate procedures for estimating genetic and non-genetic components of variation in economic characters of animals have been developed.

On the basis of the study of different methods of recording milk yield for estimating the lactation yield of cows, a systematic plan has been developed for recording milk yield in areas covered by the Key-Village Schemes.

The statistical analysis of the milk-composition data collected in four States through schemes sponsored by the Council has shown the need for a review of the quality standards of milk. Nutritional requirements of cattle have also been statistically studied. Econometric techniques are being successfully utilized in studying the feed-milk relationship to devise optimum feeding schedules. A survey for studying the economics of rearing and keeping cattle and buffaloes has been completed. Surveys for developing a technique for studying the impact of milk-supply schemes on the economy of the milk shed areas have also been undertaken.

STATISTICAL RESEARCH (SAMPLE SURVEY METHODOLOGY)

The Institute played a pioneering role in the development of techniques for estimating crop production through crop-cutting experiments based on random sampling. These techniques are being used regularly not only in India but also in many other countries of the world for estimating the production of various crops. The Institute also developed sample survey techniques for estimating the catch of marine fish. Another important area of research was to evolve suitable sampling techniques for estimating the output of major livestock products. The techniques developed have already been passed on to the States who are adopting them on a regular basis for collecting these statistics. The Institute has also conducted sample surveys for developing suitable sampling techniques for estimating the cost of production of crops and livestock products. The more recent investigations

undertaken are: (*i*) pilot sample surveys for estimating the area under production of horticultural crops, (*ii*) pilot sample surveys to study the area under and yield of spices and cashewnut crops, (*iii*) pilot sample surveys to obtain estimates of crop production at the block level in place of district level, and (*iv*) pilot sample surveys for studying fertilizer practices.

The Institute has provided expertise for the assessment of important agricultural development programmes like the Intensive Agricultural District Programme and the High-Yielding Varieties Programme. The Institute also provided consultancy and technical guidance in the assessment of intensive cattle development programme and demonstrated that sample surveys are very useful means for assessing and evaluating the benefits of development programmes in the field of agriculture and animal husbandry.

The major activities in progress at present are as follows: (*i*) Sample surveys for methodological investigations on high-yielding varieties programme under which sample surveys are conducted in 38 districts spread over 15 States of the country, for studying the changes in area and productivity of high-yielding varieties of major cereals and cash crops, and also to study the factors which inhibit the spread of high-yielding varieties programme and other practices associated with the cultivation of these varieties. (*ii*) Integrated sample survey technique for estimation of livestock products, viz. milk, wool, eggs and meat, through a sample survey conducted every year so that maximum information can be obtained with minimum cost. Research investigations have also been undertaken to develop sampling techniques for some minor but commercially important products like hides, skins, hair and bristles. (*iii*) Pilot sample surveys for studying the cost of production and marketing of apples. (*iv*) Pilot sample surveys to develop a suitable technique for estimating the area under production of cultivated fodders. (*v*) Pilot sample surveys for developing integrated techniques for estimation of production of fruits. (*vi*) Pilot sample surveys for estimating the production of vegetable crops and their marketing practices. (*vii*) Pilot sample surveys for estimating lac production and study of associated cultivation practices.

## AGRICULTURAL ECONOMICS

The important role of agricultural economics has been realized since long by the ICAR. The Council has financed a number of research schemes in various areas of agricultural economics. Very use-

ful research work is also being done in the research institutes of the Council. The Division of Agricultural Economics in the IARI is offering postgraduate training courses leading to the award of M.Sc. and Ph.D. degrees. The Division of Dairy Economics, Statistics and Management at the NDRI is also offering postgraduate training programme in dairy economics. The important research work done at the agricultural economics division of the IARI is in the field of farm management, production econ mics, agricultural finance, marketing and econometrics. Studies have been conducted on fertilizer use in high-yielding varieties, economics of pesticides use and the effects of uncertainty in weather and variation in soil characteristics on crop production and fertilizer response. In the field of irrigation, work has been done on temporal and spatial allocation of canal water for the Krishna Raj Sagar Project in Karnataka. Impact of new strategy of agricultural development on farm incomes and employment has been studied for areas like Punjab, Rajasthan, West Bengal and Delhi. A series of empirical studies on supply response of important agricultural commodities have also been undertaken. The market for perishable commodities like vegetables, apples and eggs, economics of gobar gas plants, economics of multiple cropping, and economics of dry farming are other important areas of research. The Division of Dairy Economics, Statistics and Management at the NDRI is engaged in the development of research methodology in the estimation and analysis of factors influencing the cost of milk production from different breeds of cattle. Input and output relations of dairy farms of different sizes, valuation of livestock from birth to different stages of growth, and evaluation of cattle-development programmes and the economics of dairy farming at different levels of investment are also being studied. The Council has financed an operational research project on integrated crop and milk production development for villages around Karnal. Other research schemes financed by the Council are on factors influencing the cropping pattern on individual holdings, the spread of improved agricultural practices and the factors limiting their adoption by cultivators, the economic impact of a river-valley project on the surrounding areas in the Ghataprabha left canal area, and farm and non-farm employment opportunities in selected rural areas of Maharashtra and Tamil Nadu. Schemes on mechanized farming undertaken at the Banaras Hindu University and Sree Venkateswara University, Tirupati, have provided useful information. A research project on production potential and cost of milk production in Haryana is in progress. Some

other notable studies in progress are: marketing of foodgrains in Gujarat, constraints in transfer of new technology at the IARI and factors causing wide yield fluctuations in high-yielding varieties at the MPKV. Investigations on earning and employment at small farms are in progress at Agra and Kanpur. Research on the cost-benefit analysis of agricultural research projects is also in progress at the Punjab Agricultural University.

CHAPTER 10

# TOWARDS CO-ORDINATION OF RESEARCH ON CROPS

## First Step towards Co-ordination of Research on Crops; Establishment of Composite Regional Stations for Research on Cotton, Oilseeds and Millets (PIRRCOM) 1954-1962

WITH the success achieved in research on cotton under the auspices of the Indian Central Cotton Committee since 1921, Commodity Committees were organized in respect of a number of commodities, viz. Indian Lac Cess Committee (1931), the Indian Central Jute Committee (1936), the Indian Central Sugarcane Committee (1941), the Indian Central Tobacco Committee and the Indian Central Coconut Committee (1945), the Indian Central Oilseeds Committee (1947), and the Indian Central Arecanut Committee (1949).

In due course a disadvantage was felt in the commodity approach to agricultural research, i.e. there was lack of co-ordination, and sufficient emphasis was not given to the problems of common interest to the various crops, like soil management. Administratively also there was lack of co-ordination. The Vice-President of the ICAR, who was also the President of all the Commodity Committees, was the sole co-ordinating link. However, this defect was overcome to some extent by bringing together all the Directors of the research institutes of Commodity Committees, and the Secretaries of the Committees on the Board of Research and Extension of the ICAR, where problems of common interest in the field of research and administration were discussed.

The need for intensification of the programmes of agricultural research on crops like cotton, oilseeds and millets had been felt for a number of years. It therefore became imperative for the respective Commodity Committees and the Indian Council of Agricultural Research to formulate plans for proper orientation of research in cotton, oilseeds and millets.

It was realized that in a vast country like India, with marked variations in the soil-climate complex, research on crops like cotton, oilseeds and millets—which are grown in rotation under rain-fed conditions—must be regional in character. A single central research station for a single commodity could not be expected to solve the problems con-

nected with these crops.

In 1954 the Indian Central Cotton Committee decided to regionalize research on cotton, and Rs 1 million were provided in the Second Five-Year Plan for the establishment of regional stations for research on cotton on a variety-cum-climate basis. The ICAR convened a conference of research workers on millets in 1954, and one of the recommendations of this conference was to organize research on millets on a regional basis. The Indian Central Oilseeds Committee also subsequently accepted the concept and importance of regionalization of research.

To give a practical shape to these recommendations, a subcommittee was appointed in 1956 to consider the propriety of establishing cross-commodity research stations for investigations on cotton, oilseeds and millets. This subcommittee headed by Dr B. N. Uppal, Agricultural Commissioner, recommended the establishment of 17 composite regional stations spread over the entire country for work on cotton, oilseeds, castor, groundnut, *Brassica,* sesamum, Indian rape (*toria*), rocket salad (*taramira*) and millets, sorghum or *jowar*, and pearlmillet or *bajra* for organizing research on a cross-commodity basis, ensuring maximum efficiency with the minimum of expenditure.

The Indian Central Cotton Committee, Indian Central Oilseeds Committee and the ICAR accepted these recommendations and initiated steps to implement them.

The details relating to the location and scope of work of the different regional stations/substations are given below.

| *Location* | *Crops* |
|---|---|
| Coimbatore (Tamil Nadu) | Cotton, groundnut and sorghum (*jowar*) |
| Dhadesagur (Karnataka) | Cotton and *jowar* |
| Sulakere (Karnataka) | Fingermillet (*ragi*) and groundnut |
| Bellary (Karnataka) | Setaria and *jowar* (*rabi* or winter season) |
| Dharwar (Karnataka) | *Jowar* (*kharif* or rainy season) |
| Mohol (Maharashtra) | *Jowar* (*rabi*) |
| Rajendrasagar (Andhra Pradesh) | Castor and groundnut |
| Amravati (Maharashtra) | Cotton, *jowar* and groundnut |
| Surat (Gujarat) | Cotton and *jowar* |
| Junagadh (Gujarat) | Groundnut and *jowar* |
| Hoshangabad (Madhya Pradesh) | Linseed |
| Ajmer (Rajasthan) | *Jowar* and *bajra* |

| | |
|---|---|
| Gwalior (Madhya Pradesh) | *Jowar* (*kharif*) |
| Kanpur (Uttar Pradesh) | Indian mustard (*sarson*) and *bajra* |
| Sirsa (Punjab) | Cotton |
| Patiala (Punjab) | *Toria* and *taramira* |
| IARI, New Delhi | Cotton, *jowar*, *bajra* and *linseed* |

The essential pattern of this Project for Intensification of Regional Research on Cotton, Oilseeds and Millets (PIRRCOM) was to provide a coverage for comprehensive research work on these crops, as conditioned by a wide range of agro-climatic variations in the country. A major research programme at the IARI, New Delhi, consisted of fundamental work on cytogenetics and physiology of cotton, linseed, *jowar* and *bajra*; it also included breeding of linseed for evolving varieties suitable for the northern alluvial plains.

The research stations, with the exception of the IARI, functioned under the administrative control of the ICAR. A Regional Co-ordination Committee was set up in each region to formulate a comprehensive research programme for the region as a whole, and assign items of work to the research stations located in the region. The Regional Co-ordination Committee consisted of (*i*) Agricultural Commissioner with the Government of India, (*ii*) Director of the IARI, New Delhi, and Head of the Division of Botany, IARI (for the Northern Regional Co-ordination Committee only), (*iv*) Secretary, Indian Central Cotton Committee, (*v*) Secretary, Indian Central Oilseeds Committee, (*vi*) Head of the regional station concerned, and (*vii*) specialists dealing with cotton, oilseeds and millets of the States constituting the region.

It was the responsibility of the Head of a regional station to prepare a detailed programme of research work for the region. This programme, as approved by the Subject Matter Subcommittees, was considered by the Regional Co-ordination Committee. Before the programmes were implemented at the PIRRCOM Stations, these were finally approved by the Commodity Committees concerned and the Scientific Committees of the ICAR. The Regional Co-ordination Committees met once a year at a suitable place in the region. The Head of a composite regional station was expected to provide technical guidance to the substations under it, and collaborate with the State research stations located in the region.

## ORGANIZATION AND FINANCE

Each main regional station was under the overall charge of a senior

scientist and had fully equipped sections of (*i*) Plant Breeding and Genetics, (*ii*) Agronomy, (*iii*) Agricultural Chemistry and Soil Science, (*iv*) Plant Pathology, and (*v*) Entomology, each of which was headed by a specialist. Besides these, each station had the usual quota of statistical and technical assistants, artists and ministerial staff. The substations were under the supervision of experienced plant breeders.

The cost of running the centres under this Project up to 31 March 1962 was shared by the Indian Central Cotton Committee, Indian Central Oilseeds Committee and the ICAR in the ratio of 2:2:1. The entire cost of the Project from 1 April 1962 onward was met out of the grant-in-aid by the Government of India, the scheme having been included in the Third Five-Year Plan.

CHAPTER 11

# ALL-INDIA CO-ORDINATED RESEARCH PROJECTS

THE All-India Co-ordinated Research Projects of the Council are a landmark in the history of agricultural research in India. The manner in which the new approach came into being is interesting. The Council was interested in improving maize production using hybrid vigour in the crop which had led to spectacular results in the United States and later in other countries. The first few schemes financed by the ICAR for research on hybrid vigour in maize in the States did not yield sufficiently worthwhile results. On the invitation of the ICAR, the Rockefeller Foundation, which had been carrying out fruitful research on crop improvement in Mexico, Central America and the Caribbean Region, i.e. under conditions somewhat similar to those of India, deputed two specialists on maize to visit the country and, after studying the present position regarding the cultivation of the crop in India, to make recommendations for stepping up production. As a result, Dr E. J. Wellhausen and Dr U. J. Grant, maize specialists from the Rockefeller Foundation Programme in Mexico and Columbia came to India and, after studying the position of maize crop and the research in progress, gave a valuable report.

This report was considered first by the Botany Committee of the ICAR and then by the Advisory Board of the Council. At that time Dr R. W. Cummings, Field Director of the Rockefeller Foundation, was also available for consultation. For the first time a new approach to research on the improvement of crops was formulated and adopted. Instead of financing research on the old pattern based on the political boundaries of States, the subcontinent was considered as a whole and divided into major agro-climatic zones for the purpose of research planning and funding. Specialists from the States were invited to help in finalizing the research programme along with the experts from the Centre. It was agreed that the research centres falling within the political boundaries of a State would be under the administrative control of the Government of that State, which would provide the land and laboratory facilities necessary for carrying out research and experiments The ICAR would provide all other financial assistance which might be required for carrying out research of the quality desired.

Important features were that the ICAR would provide a Project

Co-ordinator, selecting a person who was respected by his compeers and who, while continuing his own research, would be given assistance so that he might find time to visit all the centres under the project to ensure that there were no impediments in the smooth functioning of the project. The Rockefeller Foundation agreed to make available a world collection of germplasm and also, in the early stages of the project, to provide another Project Co-ordinator who would work in close co-operation with his Indian counterpart. Another important decision was that there would be annual workshop of the principal research workers on the Project which would make a critical review of the progress achieved during the year, and to make the detailed programme for the next year, keeping in view the results of this review.

The Project was so successful that within 4 to 5 years very high-yielding hybrids became available, suitable for growing in the various regions of the country. When the ICAR was re-organized in 1965-66 on the recommendations of the Marion Parker Committee, the Council on the initiative of its first scientist Director-General, Dr B. P. Pal, decided to apply the pattern of the co-ordinated maize project for the improvement of all major crops of the country. This concept was also extended to cover the field of the animal sciences. The following paragraph from the Annual Report of the ICAR for 1965-66 is pertinent:

> "A significant development in the field of agricultural research in India during the year under report was the formulation of All-India Co-ordinated Research Projects for the improvement of agricultural crops and animals as also for investigations in the field of agronomy, soil science and agricultural engineering. A cardinal feature of these co-ordinated research projects is that they will be operated on a country-wide basis under the direct supervision and technical guidance of the Indian Council of Agricultural Research. Each project will be headed by a full-time Project Co-ordinator and a number of Zonal Co-ordinators and Technical Project Leaders. In this way the Central research institutes, as well as the agricultural universities and departments of agriculture in States where agricultural universities do not exist, will work as a team in the solution of the important agricultural research problems. This is a significant departure from the practice in the past when research effort was made in a fragmentary and isolated manner. The All-India Co-ordinated Research Projects provide a major and an important forum and vehicle for

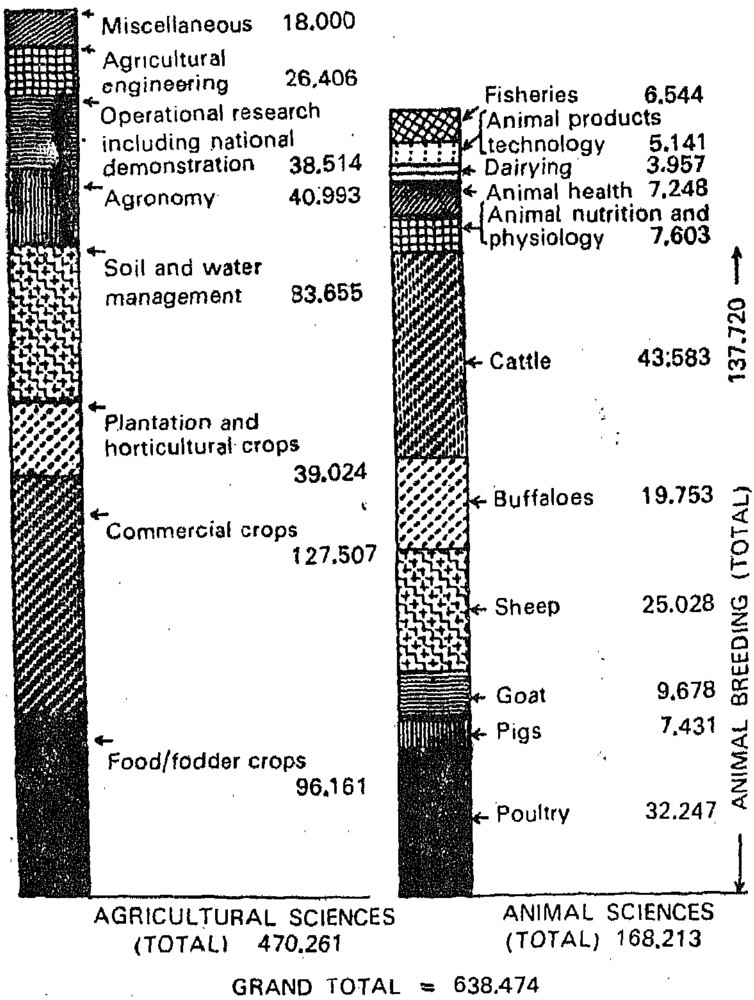



Fig. 4. Distribution of funds (in million rupees) under All-India Co-ordinated Research Projects (1965-79)

placing agricultural research in the country on a sound basis. Co-ordinated projects have been formulated for the improvement of all the important crops and animals and for solving problems connected with soil management and irrigation, by Special Expert Committees constituted by the Council during the year under report."

EXPANSION OF PROJECTS AND THEIR REVIEW

Within 3 years from 1965, 70 all-India co-ordinated research projects were launched, accounting for 40% of the total outlay for agricultural research in the Fourth Five-Year Plan. During the Fifth Five-Year Plan the co-ordinated projects were critically reviewed and a number of them that had fulfilled their objectives were closed down. Some were integrated with the other related projects. A few were converted into co-ordinated programmes which were different from the co-ordinated research projects because of their nature and magnitude of work or both. Some of the projects have been elevated to the level of Project Directorates with additional responsibilities, in view of their importance, such as on oilseeds, pulses, rice, wheat, dryland agriculture, etc. Thus during the Fifth Five-Year Plan there were five Project Directorates and 49 all-India co-ordinated research projects. In addition, a few co-ordinated programmes were developed to intensify research on such specialized and important aspects like rodent control, nematode control, biological control, weed control, research on algae as a source of biological nitrogen and protein food etc.

The essential differences between these three categories of programmes are as follows:

PROJECT DIRECTORATES

These are essentially the same as those of the all-India co-ordinated research projects except for their size and the magnitude of work involved. In addition, the project directorates undertake research on important aspects, besides playing such national service roles as the maintenance and supply of germplasm, organizing off-season nurseries to promote and speed up research interests, pest and disease monitoring, forecasting and issuing early warning about the pest and disease outbreak, and perform such duties as lead centres in relation to their respective subject matter. There is a Project Director as a head, assisted by a number of Associate Project Co-ordinators or Associate Directors along with a group of scientists.

## Co-ordinated Projects

The co-ordinated research projects operate on the national basis through inter-disciplinary multi-location research approach. The principle of their functioning is to provide scope and opportunity for wider evaluation of the proven results of applied value. Their sources of experimental material and technology are the agricultural universities and the central institutes. Sometimes they also generate certain knowledge which gets integrated into the technology from other sources. By virtue of their multi-location testing mechanism, they have been able to cover simultaneously a wide range of agro-ecological conditions in a wider socio-economic background and speed up spread and application of results of research. They provide functional linkages between the institutions and scientists working on related problems. The centres are located both in the agricultural universities and the central institutes. Sometimes certain private institutions, institutions of other scientific organizations and traditional universities are also involved either on cost-sharing or cost-free voluntary basis.

At the co-ordinated research centres the work is inter-disciplinary and the need-based scientific staff is provided to tackle the problems in an integrated manner. The Co-ordinating Unit consists of a Project Co-ordinator of a sufficiently high level of competence who could provide scientific leadership to the project. He is assisted by a supporting personnel and performs the co-ordination duties through the co-operation of senior scientist in the form of Principal Investigators located either in the project or in the related institutes. The co-ordinating units are located either in the agricultural universities or in the central institutes. The functions of the Project Co-ordinator are to plan, guide, supervise, co-ordinate, and monitor progress of research. He is also accountable for the project work.

## Co-ordinated Programmes

Relatively, co-ordinated programmes are smaller projects, although in principle they perform the same functions as that of the all-India co-ordinated research projects. There is no project co-ordinator and the related structural component. Instead the co-ordination functions are performed by a Principal Investigator of scientific repute.

The project directorates, all-India co-ordinated research projects and co-ordinated research programmes are administered by the ICAR and funded fully from the central resources. However, the co-ordinated research project centres located in the agricultural universities and

the other State institutions derive central assistance up to 75% and the remaining 25% is met from the State resources. However, in functioning there is no difference between the State and Central sector participation. It is the concept of collective endeavour that is the keynote of functioning of the all-India co-ordinated research projects which, through sustained team work, have endeavoured to achieve results of significance in wheat, rice, sorghum, cotton, etc.

At the close of the Fifth Five-Year Plan there were 54 all-India co-ordinated research projects. These projects have two components: (*i*) Co-ordinating Unit, and (*ii*) Co-ordinated Research Centre. The co-ordinating unit consists of the project co-ordinator with or without the associate project co-ordinator and a supporting personnel. The co-ordinated research centres, which are multi-disciplinary in their functioning, are located in the agricultural universities or central institutes in the regions where the subject-matter of the project is important.

The criteria for the selection of locations for the co-ordinated research centres are (*i*) importance of the crop or livestock species in the region and specific problems therein, and (*ii*) availability of infrastructural facilities for locating such a centre. Even if facilities for locating such a centre are not available and the region is important from the crop or livestock species or specific problems point of view, then facilities are developed to enable the co-ordinated project research centre to operate.

The objectives of the all-India co-ordinated research projects are to undertake problem-oriented applied research and testing of knowledge or technology under different broad agro-climatic conditions. The problems studied should be of national importance and their aim should be to develop recommendations in the shortest possible time to improve production or solve the problems for which the research effort was mounted.

These were the principles on which the all-India co-ordinated research projects were developed and executed during the last three plan periods. By and large some of the projects have done exceedingly well in discharging their role. But in a fast-changing agricultural pattern in the country, restructuring of the system is necessary in respect of organization, functioning, management and system design or modelling if the co-ordinated research systems were to povide an effective instrument for testing known knowledge and for transferring technology from one area to the other.

The benefits that have accrued from the all-India co-ordinated research projects have resulted in stabilizing the economy of the agricultural systems as a whole and production and productivity in particular.

## CROP RESEARCH

In cereals and millets gratifying results have been obtained and a number of high-yielding varieties and hybrids were evolved and released for cultivation. Continuous efforts were made to improve the yield of these varieties and hybrids, but the major emphasis was on the prevention of crop losses due to the incidence of pests and diseases by formulation of newer and more efficient plant-protection schedules or by breeding disease- and pest-resistant varieties. Minor millets, on which much work has not been done earlier and which constitute a poor man's staple food, have received special attention under the Co-ordinated Millet Improvement Project. Similarly, emphasis has been laid on the improvement of pulse crops, since the pulses constitute an important source of protein in Indian diet. In the crop improvement projects, major considerations were the improvement of their nutritive value, especially in protein content and quality. In commercial, horticultural and plantation crops, emphasis was given for high-yielding and disease- and pest-resistant varieties. Improvement in the quality of the produce such as fibre in cotton, jute and other fibre crops and oil content and quality in oilseeds crop were aimed at. The production of nucleus seeds of improved varieties was also undertaken under the co-ordinated projects. The control of major diseases and pests of crops was attempted. Researches were also conducted to forecast epidemics of major diseases and pests, and develop early warning systems.

The new strategy for increasing agricultural production, which was triggered off primarily due to the development of high-yielding varieties of crops, needed massive support for research in related fields such as fertilizer use, irrigation and use of pesticides for maximizing not only the yield per unit area but also production per unit of time. The breeding of short-duration varieties has made multiple cropping a distinct possibility, and has laid the basis for the concept of increased production per unit of time. The co-ordinated research projects in soils, agronomy and water management have played a pivotal role in stabilizing the cropping systems.

## RESEARCH ON ANIMALS

The major causes of low productivity were the genetic deterioration

of livestock due to indiscriminate and unplanned breeding and poor culling of inferior stocks over the generations, shortage of feed and fodder and prevalence of livestock diseases. The co-ordinated research projects in animal sciences were geared up to undertake research on their breeding, nutrition, disease control and management for developing high-yielding breeds to augment the supply of milk, meat, eggs and wool. Besides the co-ordinated projects on animal breeding (including cattle buffalo, poultry, sheep, goats and pigs), animal nutrition, animal health and animal production and dairying, projects were taken up for developing superior technology for processing animal products, improvement of fodder and forage crops, and grasses and grassland management.

In fisheries and fish technology, the work carried out under composite fish-culture project has helped considerably in the production and management of fish. The induced breeding of fish has opened up a new vista in the production of fry and fingerlings.

### Reasons for Success

It would be interesting to analyse the reasons for the success of this unique pattern of research programme, which at the time it was conceived of and put into practice in India was not found in any other country of the world. Its most outstanding feature is the co-operation between the scientists working in the States in agricultural universities (formerly in some cases in institutes of the Department of Agriculture) and the scientists of the central institutes. Though formerly there was reluctance on the part of the scientists working in a State to co-operate with those at the Centre or any other State, the fact that now the programming was on a soil-climate basis and not on a political-boundaries basis, with all the scientists concerned working as equal partners, both in drawing up programmes and in implementing them, made it possible for all concerned to work in a spirit of goodwill and enthusiastic co-operation.

The next factor responsible for the success of these programmes was the appointment of a full-time project co-ordinator in the person of a scientist of sufficient competence to have the respect of his compeers, whose duty was to see that the experiments were laid out according to plan and that bottlenecks were detected early by personal visits, and removed as early as possible. The project co-ordinators were provided with some assistance so as to make it possible for them to do all this in addition to a certain amount of research work of their own. In the early stages the project co-ordinators were located at the IARI be-

cause it had the facilities required, and communication with all the other research centres was facilitated. Later on there was a move to transfer some of the project co-ordinators to suitable agricultural institutions outside Delhi.

Yet another reason why these co-ordinated programmes achieved very good results in a short time, was the fact that a world collection of the varieties of the crop were made available to the plant breeders at the commencement of each project so that they started with the best possible material. This germplasm was assessed for disease and pest resistance by the plant pathologists and entomologists working in the project. The breeding of high-yielding genotypes was a basic vital feature of these crop-improvement programmes, because without the availability of a suitable genetic base other inputs like fertilizer etc. could not give the maximum results in production. It is well known that when attempts were made before the introduction of the dwarf wheats and dwarf rices to give high doses of fertilizers to boost production, the crops lodged and there was inadequate return for the money spent on fertilization. While in wheat and rice the new dwarf varieties formed the basis on which higher productivity was built, in *jowar*, *bajra* and maize the phenomenon of hybrid vigour was used.

Another important feature of the all-India co-ordinated programmes has been the annual workshop meetings (there are two each year in rice, because two or three crops of rice are raised in some areas within a 12-month period), at which the results of the experiments carried out during the previous year are critically analysed and a programme drawn up for the next season keeping in mind the lessons learnt It is at these workshop meetings that recommendations are made about the varieties to be released for general cultivation and also the agronomic practices to be followed such as time of sowing, seed rate, spacing, irrigation intervals, doses of fertilizers, etc. to get the best results.

### Benefits of Co-ordinated Research Projects

The uniqueness of the system of co-ordinated projects is that the experimental material generated and the technological innovations and discoveries made in the central institutes and agricultural universities are carried by the all-India co-ordinated research set up for wider field experimentation under different agro-ecological and socio-economic conditions. Thus it characterizes the combined State-Central responsibilities in agricultural research by avoiding the wasteful duplication in terms of deployment of money, manpower and time, besides attempting to harmonize the regional disparities in respect of growth in agricultural

research. The experience of this system is indeed rewarding in that it has promoted the sense of unity of thought and deed, maximized the benefits from the investments and has speeded up the progress of research.

CHAPTER 12

# REORGANIZATION OF THE ICAR

## Phase I. Agricultural Research Review Team Report

### Abolition of Commodity Committees; and Transfer of all Research Institutes to ICAR 1963-65

IN 1963 an expert committee, the Agricultural Research Review Team, which was headed by Dr Marion Wesley Parker of the USDA, was appointed by the Ministry of Food and Agriculture, Government of India, to enquire into the existing research set-up and to suggest suitable changes. The other members of the team were : Dr Roy Lee Lovvorn, Dr Oscar Burr Ross, Dr E. E. Cheesman, Dr L. Sahai, Dr K. Ramiah and Prof. P. Maheshwari. Dr S. K. Mukerjee, Deputy Agricultural Commissioner (Education), ICAR, was appointed the Liaison Officer. The Team submitted its report on 19 March 1964. The Team felt that while the ICAR had supported research and had made a significant contribution to its integration, it suffered from limitations as a co-ordinating body, because its control was restricted only to the schemes financed by it; even that control was not perfect. The number and the scope of the schemes increased so much that the Council, with its very meagre technical staff, could not exercise effective supervision. It had also no authority to supervise the schemes initiated at the institutes established by the Central Commodity Committees. These Commodity Committees were set up by the Ministry of Food and Agriculture for intensifying research on cotton, jute, tobacco, oilseeds, sugarcane, coconut and arecanut, and for accelerating developmental activities connected with these crops. Further, there were other institutes conducting research on agricultural problems with which the Council was not directly associated.

A recommendation made by the Committee was to abolish the ICAR and replace it by a Council for Agricultural and Food Research. This recommendation was rejected outright, as it meant cutting all the links with the past. Moreover, nothing prevented the ICAR from undertaking research on the subjects which the Committee had in view.

#### LINES OF REORGANIZATION

After examining the recommendations made by the Agricultural

Research Review Team, in consultation with agricultural scientists and experienced administrators, the Government of India approved of the reorganization of the Council on the following lines :

The reconstituting of the Indian Council of Agricultural Research as a fully autonomous organization, without changing the present name of the society;

The bringing of all the research institutions under the control of the Departments of Food and Agriculture, including those under the Central Commodity Committees, under the reorganized Council; the reconstituting of the Governing Body of the Council, with a view to making it pre-eminently a body of scientists and those with interest in or knowledge of agriculture;

The redesignating of the Indian Agricultural Research Institute, the National Dairy Research Institute and the Indian Veterinary Research Institute as national institutes, and delegating to them and other institutes enhanced administrative and financial powers;

The giving of financial assistance for research to State institutes and universities by the reorganized Council in the form of block grants on the model of the Atomic Energy Commission;

The making of arrangements for recruitment to scientific posts through its own selection committees consisting of outstanding scientists; and the appointing of an agricultural scientist as the chief executive of the Council, with the designation of Director-General.

PROGRESS OF REORGANIZATION

The rules and bye-laws of the Council were revised to make the Council a really functional, technically competent and adequately autonomous research organization.

The Governing Body was reconstituted, making it pre-eminently a body of scientists and those with interest in or knowledge of agriculture. A scientist was appointed in May 1965 as the Director-General and Vice-President of the Council, departing from the tradition of appointing only an administrator to this post. To assist the Director-General on the technical side, four posts of Deputy Directors-General were created, one each for (*i*) Crop Sciences, (*ii*) Soils, Agronomy, Irrigation and Agricultural Engineering, (*iii*) Animal Sciences, and (*iv*) Agricultural Education.

ADMINISTRATION OF RESEARCH CENTRES

The administrative control of all the research institutes and soil-conservation research, demonstration and training centres was transferr-

ed to the Council in the wake of its reorganization. All the commodity research institutes which were formerly under the administrative control of the Commodity Committees were also taken over by the Council. Two new research institutes were also started, viz. the Institute of Horticultural Research, Hessaraghatta (Karnataka), and the Central Soil Salinity Research Institute, Karnal (Haryana).

The total number of research institutes under the Council now is 33 as listed below.

AGRICULTURE

1 Indian Agricultural Research Institute, New Delhi
2 Central Arid Zone Research Institute, Jodhpur (Rajasthan)
3 Cotton Technological Research Laboratory, Matunga, Bombay (Maharashtra)
4 Indian Grassland and Fodder Research Institute, Jhansi (Uttar Pradesh)
5 Indian Institute of Horticultural Research, Bangalore (Karnataka)
6 Jute Agricultural Research Institute, Barrackpore (West Bengal)
7 Jute Technological Research Laboratories, Calcutta (West Bengal)
8 Indian Lac Research Institute, Namkum, Ranchi (Bihar)
9 Central Plantation Crops Research Institute, Kudlu, Kasaragod (Kerala)
10 Central Potato Research Institute, Simla (Himachal Pradesh)
11 Central Rice Research Institute, Cuttack (Orissa)
12 Central Soil Salinity Research Institute, Karnal (Haryana)
13 Indian Institute of Sugarcane Research, Lucknow (Uttar Pradesh)
14 Sugarcane Breeding Institute, Coimbatore (Tamil Nadu)
15 Central Tobacco Research Institute, Rajahmundry (Andhra Pradesh)
16 Central Tuber Crops Research Institute, Trivandrum (Kerala)
17 Central Institute for Cotton Research, Nagpur (Maharashtra)
18 Central Soil and Water Conservation and Training Institute, Dehra Dun (Uttar Pradesh)
19 Central Institute of Agricultural Engineering, Bhopal (Madhya Pradesh)
20 Vivekananda Parvatiya Krishi Anusandhan Shala, Almora (Uttar Pradesh)
21 National Bureau of Plant Genetic Resources, IARI Campus,

New Delhi

22 National Bureau of Soil Survey and Land Use Planning, Nagpur (Maharashtra)

23 ICAR Research Complex for North-Eastern Hills Region, Shillong (Assam)

24 Central Agricultural Research Institute for Andaman and Nicobar Group of Islands, Port Blair

25 National Academy of Agricultural Research Management, Hyderabad (Andhra Pradesh)

VETERINARY, ANIMAL HUSBANDRY AND FISHERIES

26 Indian Veterinary Research Institute, Izatnagar (Uttar Pradesh)

27 National Dairy Research Institute, Karnal (Haryana)

28 Central Inland Fisheries Research Institute, Barrackpore (West Bengal)

29 Central Marine Fisheries Research Institute, Cochin (Kerala)

30 Central Institute of Fisheries Technology, Cochin (Kerala)

31 Central Institute for Fisheries Education, Bombay (Maharashtra)

32 Central Sheep and Wool Research Institute, Avikanagar (Rajasthan)

STATISTICS

33 Indian Agricultural Statistics Research Institute, New Delhi.

CHAPTER 13

# REORGANIZATION OF THE ICAR

## Phase II. Gajendragadkar Committee

## Appointment of Agricultural Scientists' Recruitment Board; Restructuring of Governing Body; and Abolition of Advisory Board

## 1972-73

THOUGH the responsibilities of the ICAR were greatly enlarged after 1966, the Secretariat of the Council, however, continued to remain as an attached office of the Department of Agriculture of the Government of India, thus limiting its effectiveness. Also the personnel policies and recruitment system adopted by the ICAR after the reorganization in 1965 did not meet the requirements of the situation. There was some dissatisfaction with these policies among the scientists. The Government of India therefore appointed a committee in June 1972 under the chairmanship of Mr Gajendragadkar, retired Chief Justice of the Supreme Court, to review the recruitment and personnel policies of the ICAR institutes and centres working under it, and to suggest measures for their improvement. The Committee was also required to consider any other relevant matter which, in the opinion of the Committee, would help it to make effective recommendations.

This Committee submitted its report to the Government on 19 January 1973. The recommendations of the Committee were examined by a group of Ministers headed by the Minister for Agriculture. The Government of India approved the following recommendations of the Group of Ministers :

Restructuring of the ICAR structure so as to confer on the ICAR greater autonomy and flexibility in its operational and management procedures;

Establishment of a Department of Agricultural Research and Education in the Ministry of Agriculture to provide the ICAR with the requisite linkages with the Central and State Government agencies and in international collaboration in agricultural research and education, and designating the Director-General, ICAR, concurrently as Secretary to the Government of India in the Department of Agricultural Research and Education;

Initiating a recruitment procedure through a special Agricultural Scientists' Recruitment Board with an eminent agricultural scientist as a whole-time Chairman;

Development of a new personnel system for the ICAR which does not involve recurrent applications and competition, with appropriate provision for direct recruitment at different levels with the following provisions:

1 Possibility of promotion through an appropriate assessment procedure up to the scale Rs 1500-2000 irrespective of the occurrence of vacancies;
2 Provision for a certain inflow of new talent at all levels;
3 Direct recruitment through advertisements to posts at higher levels;
4 Provision for filling up research management posts through transfer/deputation.

Setting up of Executive and Management Committees in the research institutes so as to broad-base the decision-making process and ensure effective implementation of approved research and training programmes and decentralization of powers all along the line.

PROGRESS OF RESTRUCTURING

Accordingly, the Council was restructured on the following lines:

A Department of Agricultural Research and Education was established with effect from 15 December 1973 to provide the ICAR with the requisite linkages with the Central and State Government agencies and to deal with administrative aspects of international collaboration in agricultural research and education, and the Director-General, ICAR, was concurrently designated as Secretary to this Department;

The composition of the Council, which was large, diffused and lacking in flexibility, was modified so as to restrict the number of membership and to make it a more business-like body with the Minister of Agriculture as its President;

The Governing Body was also restructured with the Director-General, ICAR, as its Chairman;

The Advisory Board was abolished since the membership of the Council is now broad-based, enabling discussion of the wide spectrum of the problems relating to the development and organization of agricultural research and education in the country.

Similarly, the Standing Committees were abolished and their functions entrusted to the Scientific Panels. These panels are listed below.

I Agriculture
  1 Plant Breeding
  2 Plant Pathology
  3 Entomology and Nematology
  4 Agronomy and Soil Sciences
  5 Horticulture
  6 Agricultural Engineering
  7 Post-harvest Technology
  8 Plant Physiology and Biochemistry
  9 Microbiology
II Animal Sciences
  10 Animal Breeding
  11 Animal Nutrition and Physiology
  13 Dairy and Livestock Products Technology
  13 Animal Health
  14 Fisheries
III Miscellaneous
  15 Agricultural Economics, Statistics and Marketing
  16 Home Science
  17 Agricultural Education
  18 Tribal Areas

The entire country was divided into eight agro-ecological regions and Regional Committees were set up for each of these regions. The Regional Committees were headed by the Director-General, ICAR, and had representatives of technical personnel from the agricultural universities, State departments, Central institutes and the Department of Agriculture in the Centre. The Regional Committees reviewed the status of agricultural research and education in the respective regions and discuss in depth the location-specific problems of agriculture.

The Governing Body of the Council is serviced by Norms and Accreditation Committee for agricultural universities and scientific panels. The Norms and Accreditation Committee *inter alia* deals with the allocation of funds to agricultural universities on the basis of the assessment of their needs, opening of postgraduate and undergraduate courses in the universities, selection of candidates for scholarships and fellowships and maintenance of educational standards.

The scientific panels for various disciplines consider schemes and projects for research relating to the respective disciplines. Some inter-disciplinary panels have also been constituted to consider schemes for collaboration in research with other research agencies, such as the

CSIR, ICMR and ICSSR.

To broad-base the decision-making process at the institute level, Boards of Management and Management Committees have been set up in the research institutes of the ICAR under the chairmanship of the respective directors. Matters to be placed before the Management Committees for consideration include (i) proposals for five-year and annual plans, (ii) periodical review of progress of research schemes, (iii) proposals for annual budget, (iv) items of expenditure which are beyond the powers of the directors, (v) policy issues relating to the institutes, including rights and obligations of, and any other items as may be desired by the director or other members of the Committee.

A new personnel policy has been developed by the ICAR in accordance with the decision of the Government. Under this policy, all posts in the ICAR are classified as scientific, technical, administrative, auxiliary and supporting, according to the nature of their duties. An Agricultural Research Service has been created to facilitate optimal utilization of available manpower and for enabling the desired mobility of scientists from one position to another as may be required in the interest of agricultural research and education. The cadre is common to the Council as a whole. While the initial constitution of the cadre has been made from those scientists who are already in position, subject to the satisfaction of the minimum qualification and scientific standards, the future recruitment to the cadre will be done by various methods indicated below.

Initial induction through an all-India competitive examination and interviews to be conducted by the Agricultural Scientists' Recruitment Board. The first examination was conducted in March 1976, as a result of which 516 scientists were selected to the S-1 Scale (Rs 700-1300) of the Agricultural Research Service. They undergo during their 2-year probationary period a 1-year training programme consisting of 3 months' foundation course followed by eight months' training in the respective disciplines and field work in the rural areas for gaining knowledge and experience of the socio-economic constraints affecting the transfer of research findings to the users of farm research and of experience in working as scientists under conditions existing in the rural areas. For the foundation course the ICAR has organized the Central Staff College for Agriculture, now named National Academy of Agricultural Research Management.

Spotting of talented scientists with a specialized background as may be needed to fill critical gaps in the Councils' research programmes;

Direct recruitment through advertisement at higher levels to meet the gaps as identified in the process of manpower planning by the Council;

Appointment to managerial positions on a *time-bound basis with* provision for renewal of the term of appointment; and

Invitations to eminent Indian scientists by the Director-General, ICAR, with the concurrence of the Agricultural Scientists' Recruitment Board and the approval of the Governing Body.

CHAPTER 14

# ORGANIZATIONAL SET-UP OF THE ICAR

Agricultural Research Service; Research Grants, Incentives to Researchers; Grants-in-Aid to Scientific Societies

THE Minister of Agriculture and Irrigation in the Government of India is the President of the Council, and the Minister of State dealing with the ICAR is the Vice-President. The Director-General of the ICAR is the principal executive of the Society. He is concurrently the Secretary to the Government of India in the Department of Agricultural Research and Education. He also functions as the principal adviser to the Central Government on all matters connected with agriculture, animal husbandry research and education.

The Council functions through the following bodies:

*Governing Body.* The Governing Body is the chief executive and decision-making authority of the Society. It is presided over by the Director-General, ICAR, and is pre-eminently a body of scientists and others with interest in and knowledge of agriculture. It decides the policies of the ICAR, approves the research programmes and projects, and controls the budget of the Council.

*Standing Finance Committee.* This Committee is also presided over by the Director-General, ICAR, and is in a way a subcommittee of the Governing Body. It examines the budget proposals of the Council, including research projects involving financial implications, and also examines the annual budget of the Council before submission to the Governing Body.

*Norms and Accreditation Committee.* The Director-General, ICAR, presides over this Committee, which consists of five Vice-Chancellors of agricultural universities nominated by the President of the Society. This Committee determines the norms for financial assistance from the ICAR to the agricultural universities and ensures maintenance of standards of education in agricultural and animal sciences.

*Regional Committees.* Eight Regional Committees have been constituted one each for the eight agro-ecological regions. These Committees are headed by the Director-General, ICAR, and have representatives of the State Departments of Agriculture, agricultural universities and central institutes. These Committees review the status of agricultural research and education in the respective regions and make recommenda-

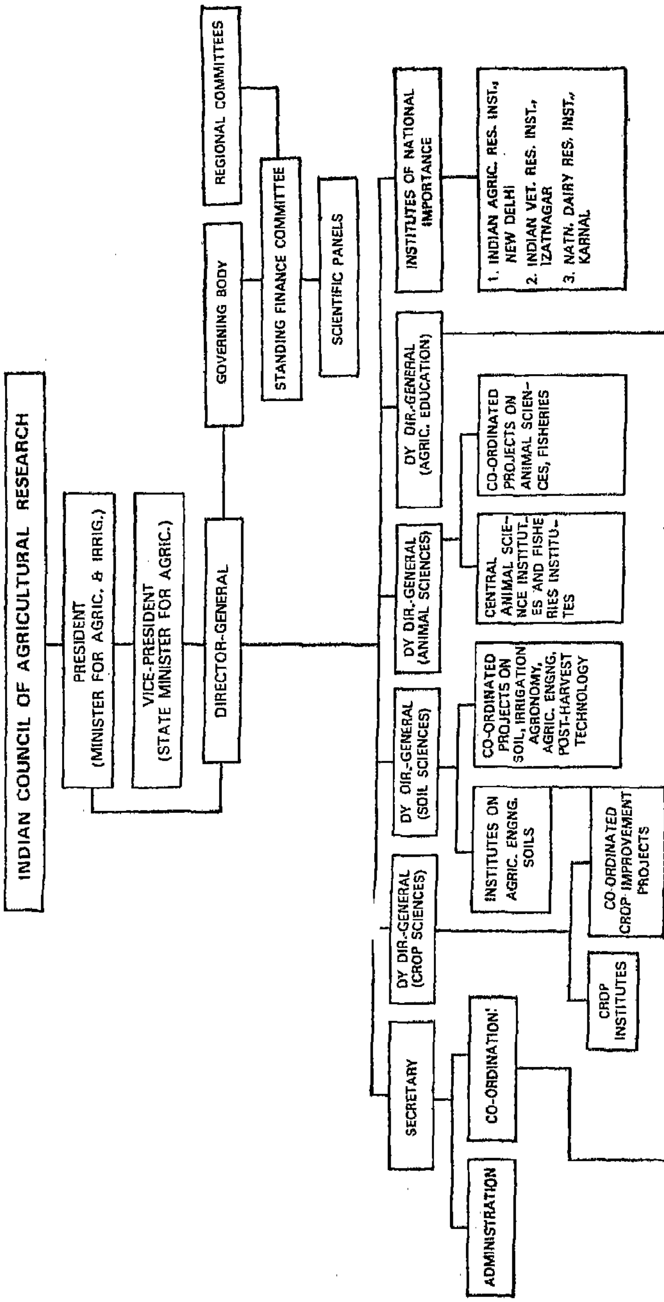



Fig. 5. Organizational chart of the ICAR

tions to the Governing Body relating to location-specific problems of that region.

*Scientific Panels.* The ICAR has 18 Scientific Panels for various disciplines, which consider schemes and projects relating to those disciplines. There are also five Inter-Disciplinary Panels. Besides considering schemes for research, the scientific panels may also advise the Governing Body on technical matters and draw its attention to gaps in the current research and training efforts.

On the technical side, the Director-General is assisted by four Deputy Directors-General, viz. (*i*) Crop Sciences, (*ii*) Soils, Agronomy, Irrigation and Agricultural Engineering, (*iii*) Agricultural Education, and (*iv*) Animal Sciences. The Deputy Directors-General are assisted by Assistant Directors-General and other technical officers. Each Deputy Director-General is responsible for the preparation, scrutiny and technical control of research schemes within his discipline.

On the administrative side, the Director-General is assisted by the Secretary of the Council, who is also Joint Secretary in the Department of Agricultural Research and Education. The Secretary is assisted by a Director of Personnel, a Director of Audit and Accounts, three Additional Secretaries, a Legal Adviser, an Internal Financial Adviser and a number of Under-Secretaries and other administrative staff.

The activities of the Council are financed by the Government of India by outright grants-in-aid and from receipts of agricultural produce cess fund. To impart the desired degree of operational flexibility and speed in project implementation, the Government of India have agreed to give a lump sum grant to the ICAR every year. This will be composed of two parts—Plan and Non-Plan. It will be within the competence of the Society to economize on certain items and re-appropriate funds for other purposes within the charge of the Society. As regards Plan outlay, the Society shall have competence to re-appropriate from one approved scheme to another, provided the total outlay of all schemes for a 5-year period does not exceed the approved outlay in the Five-Year Plan, subject to such guidelines and restrictions, if any, as may be prescribed from time to time. The Finance Secretary is associated with the ICAR as a Member of the Governing Body and advises the Society on all matters relating to its budget and expenditure.

## AGRICULTURAL RESEARCH SERVICE

As another measure of reorganization, the prevalent system of personnel management, including recruitment, promotion, transfer, etc.,

has been completely reoriented in the Council. One of the major steps taken in this direction is the constitution of a separate service for the scientists of the Council, known as Agricultural Research Service. The principles of the Service have been so devised as to attract promising graduates and postgraduates from the universities as have an aptitude for research work and also to induct proven talent and experience by direct recruitment of highly qualified scientists.

The following grades of scientists are covered under the Service :

| | |
|---|---|
| Scientist (S) | Rs 550-900 |
| Scientist (S-1) | Rs 700-1300 |
| Scientist (S-2) | Rs 1100-1600 |
| Scientist (S-3) | Rs 1500-2000 |

One of the notable features of the Service is the system of career advancement from one grade to another, irrespective of the occurrence of vacancies or grant of advance increments in the same grade on the basis of 5-yearly assessment of performance. There is also a provision for allowing a personal scale of pay higher than the highest grade of Service in recognition of outstanding performance in research.

Grade 'S' of the Service is intended to be a temporary grade to accommodate the existing employees into the service as no direct recruitment is envisaged to this grade. The Service provides for the usual methods of recruitment, including all-India competitive examination to grade S-1. Positions in grades S-2 and S-3 are intended to be filled by promotion with the operation of a system of career advancement. However, direct recruitment through advertisement to these grades may also be resorted to fill critical gaps that might be noticed in the management of the scientists' cadre.

For scientific positions above grade S-3, a separate set of service rules is being evolved. It is proposed to cover the following grades under these rules :

| | |
|---|---|
| Grade S-4 | Rs 1800-2250 |
| Grade S-5 | Rs 2000-2500 |
| Grade S-6 | Rs 2500-3000 |
| Grade S-7 | Rs 3000 (fixed) |
| Grade S-8 | Rs 3500 (fixed) |

The posts in these grades are to be filled on tenure basis for a period of 5 years subject to renewal for another term not exceeding 5 years. It is also envisaged that the posts of Directors of ICAR institutes will carry the next scale of pay as the alternative scale to be offered at

the time of selection, to the deserving candidates. This is designed to attract scientists with exceptionally distinguished record of productive research and leadership in the relevant scientific fields. It is also proposed that on transfer of an incumbent from one post to another, he will carry his own scale irrespective of the scale assigned to the post.

## RESEARCH GRANTS

The promotion of agricultural and animal sciences research being its prime objective, the Council, in addition to conducting research by itself through its constituent research institutes, sponsors and supports a large number of short-term, result-oriented, *ad-hoc* research schemes for finding solutions for critical problems that limit production in the field of agriculture, animal husbandry, fisheries and allied sciences.

The Council gets a grant from the Government of India both under Plan and non-Plan. In addition, certain percentage of agricultural produce cess collected from all the exportable agricultural commodities is passed on to the Council. Funds have also been allocated for agricultural research from PL-480 funds as well as from the special funds set apart by the Government of India for aiding research in critical areas of economic growth. Funds are also received from the international and national bodies such as the UNDP, IDRC, SIDA, DANIDA, and so on.

The ICAR supports a large number of *ad-hoc* schemes undertaken by the State Governments, general universities, agricultural universities, and private and public institutions. The entire recurring expenditure on *ad-hoc* schemes is met by the ICAR, irrespective of the implementing agencies at the national or State level. However, in regard to non-recurring expenditure, although it is expected to be provided entirely by the grant-receiving institution, under certain exceptional circumstances the ICAR bears a part of the non-recurring expenses too, mostly in respect of equipment.

The Council receives research schemes from its own institutes, agricultural universities, State governments, autonomous bodies and private institutions. The schemes are examined by the technical experts and put up for consideration before the concerned scientific panels. The schemes approved by the panel are placed before the Standing Finance Committee and the Governing Body for approval.

The Council receives schemes throughout the year. The scientific panels meet twice a year, i.e. once in May-June and again in November-December and examine the schemes. If the scheme is recom-

mended by the scientific panels, it is then considered by the Standing Finance Committee, before final approval is accorded by the Governing Body.

## INCENTIVES TO RESEARCHERS

### Rafi Ahmed Kidwai Memorial Prize

In 1956 the Council instituted the Rafi Ahmed Kidwai Memorial Prize in Agriculture, Animal Husbandry and allied sciences for providing incentive to researchers and for recognizing original and meritorious work having a bearing upon any important problem in these fields. Prizes are also given for any outstanding discovery or invention leading to results of practical value in agriculture and for making a significant advance in the knowledge of the subject. The value of each award is Rs 10 000 and 11 prizes in all are awarded in a biennium in different disciplines. Fifty-five eminent scientists have received prizes so far, including joint awards.

### Dr P. B. Sarkar Endowment Prize

Dr P. B. Sarkar, formerly Director of Jute Technological Research Laboratories, Calcutta, made a contribution to the Council for creating an endowment. The Council has, accordingly, instituted from 1971 the 'Dr P. B. Sarkar Endowment Prize' to be given to a scientist who makes an outstanding contribution, through research, to the raising of food production in the country. The scheme covers crop and animal sciences. A prize of the value of Rs 5 000 is awarded once in three years. The first award for the triennium 1971-74 has since been given to three scientists.

### ICAR Award for Team Research

In 1974 the Council instituted the 'ICAR Award for Team Research' to create incentive for promoting inter-disciplinary research in India and to recognize teams of research workers who have set high standards of co-operative endeavour in the fields of Agriculture, Animal Husbandry, Fisheries and allied sciences. The award is made for either fundamental or applied research including inventions, discoveries, etc., leading to the results of practical value in the field of agricultural and animal production.

Two awards are given in the field of Agriculture, including Agricultural Economics and Statistics, and one each in Animal Husbandry and Fisheries. A scroll of Honour is given to each team, and medals to the individual members of the team. So far one award in the field

of Agriculture has been given to a team of 9 scientists, for the biennium 1975-76.

HARI OM ASHRAM TRUST AWARD

This award has been created by the ICAR on acceptance of a donation from Hari Om Ashram Trust, Nadiad (Gujarat), in 1975. The awards, of the value of Rs 10 000 each in cash or kind or both, are to be given to two scientists annually for outstanding original research work done in India, on fundamental or applied research in the particular subject as evidenced by publication in books, monographs, papers or any other published account of outstanding research work, inventions or discoveries, in the fields of (*i*) Agricultural Sciences and (*ii*) Animal Sciences.

DR RUSTOM DARASHNA ASANA ENDOWMENT PRIZE

Dr R. D. Asana, formerly Head, Division of Plant Physiology, Indian Agricultural Research Institute, New Delhi, made a contribution to the Council for creating an endowment. This endowment was instituted in 1974. An award of the value of Rs 2 000 in cash or kind or both, triennially (once in three years) for outstanding original research on plant physiology, plant breeding, soil chemistry/physics, agricultural physics, agronomy and agricultural engineering, on improvement of knowledge or practice of dryland agriculture, is to be given once in three years. The first award was given for the triennium April 1974-March 1977.

JAWAHARLAL NEHRU AWARD

The ICAR instituted an award in 1972, named 'Jawaharlal Nehru Award', for creating incentives for high-quality fundamental or applied research amongst postgraduate students in India and to recognize outstanding research work done by them in the field of Agriculture and allied sciences. Five prizes of the value of Rs 5 000 each in cash or kind or both are awarded annually. Nineteen young scientists have so far received this distinction.

GRANTS-IN-AID TO SCIENTIFIC SOCIETIES

The Council initiated a scheme in 1953-54 for the grant of subsidy to scientific societies in the fields of Agriculture and Animal Husbandry for printing their research journals. The subsidy is given only to such scientific organizations as have their membership on an all-India basis and are registered under the Registration of the Societies Act of 1860.

The expenditure is met from the Cess Funds of the Council.

In 1967-68 the Council enlarged the scope of the schemes for financial assistance to scientific societies to cover expenditure on the following items: holding of symposia, seminars and conferences, and organizing of scientific exhibitions on such occasions, the meeting of travelling expenses of special invitees to such gatherings, deputing of representatives of societies to international conferences abroad, and the construction of buildings for offices, libraries, etc. required by the societies.

Grants of Rs 277 830 were made to about 60 scientific societies in the country during 1975-76.

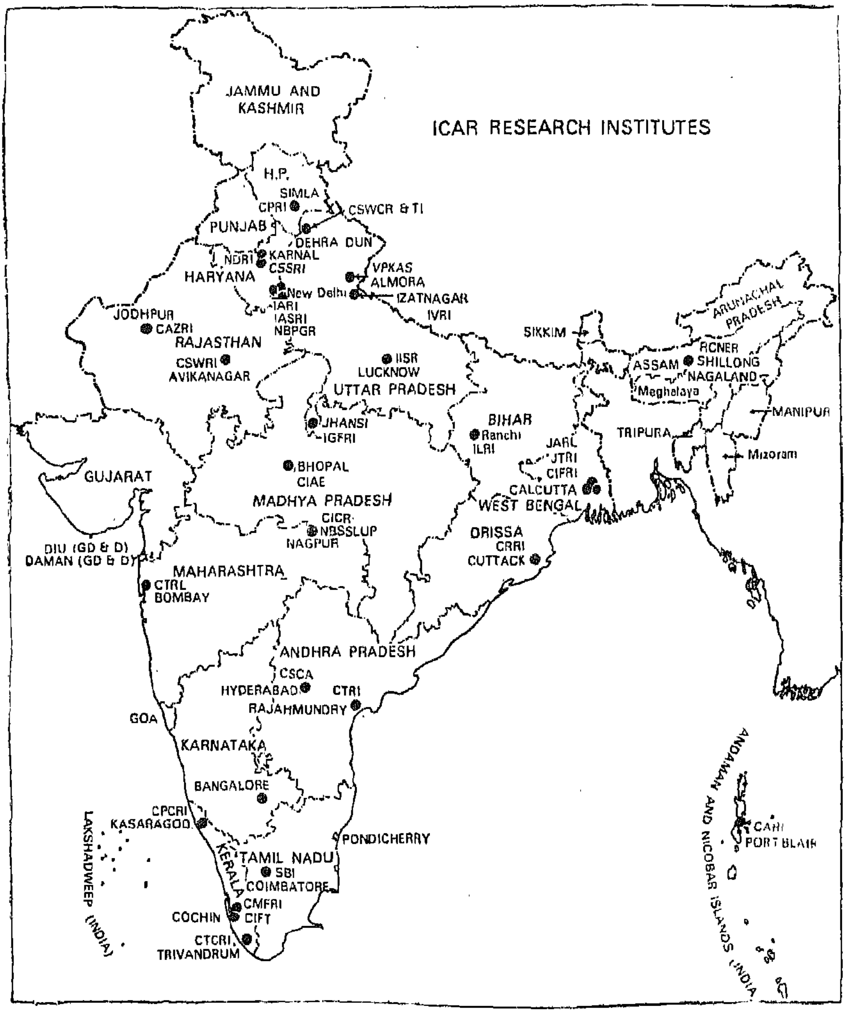



Fig. 6. ICAR research institutes

CHAPTER 15

# INDIAN AGRICULTURAL RESEARCH INSTITUTE NEW DELHI (1905)

How the Agricultural Research Institute was founded at Pusa, a village in the Darbhanga district of north Bihar, in 1905 due to the efforts of Lord Curzon, the Viceroy of India, and the generosity of Mr Henry Phipps, an American philanthropist, has been described in Chapter 2. The main building at Pusa was named after its donor as the Phipps Laboratory. With the establishment of the Institute, the posts of the Imperial Agricultural Chemist, the Imperial Mycologist and the Imperial Entomologist were transferred to this institute and additional posts of Director of the Institute, Agri-Horticulturist and Biological Botanist created. The latter two posts were subsequently re-designated as Imperial Agriculturist and Imperial Economic Botanist respectively. The Institute thus started with five sections, viz. Agriculture and Cattle Breeding, Chemistry, Economic Botany, Entomology, and Mycology. In 1907-08 a section of Bacteriology was constituted.

Pusa suffered from a disastrous earthquake in 1934. Two deep fissures appeared along the length of the Phipps Laboratory, which housed the library and the main sections of the Institute. As a result, the foundations and the two wings were damaged considerably. The Government of India after careful consideration decided to rebuild the Institute at New Delhi because of its central location and facilities. The transfer to New Delhi was completed by the end of October 1936. The Marquess of Linlithgow, the then Viceroy of India, declared the Institute open on 7 November 1936.

The Institute is located in a beautifully laid out colony, covering an area of about 500 ha. The soil is sandy to sandy loam and there is good irrigation facility. The average rainfall is about 584.2 mm, of which about 50 to 75 mm is received during the winter months. The maximum temperature during the year ranges between 11.4°C and 46.7°C and the minimum between 1.1°C and 33.2°C respectively

The Institute was renamed successively as the Imperial Institute of Agricultural Research, Imperial Agricultural Research Institute and in 1947 as the Indian Agricultural Research Institute (IARI).

## EDUCATION

In 1923 the Institute introduced a 2-year postgraduate diploma course, leading to the Associateship of the Institute. The course consisted of theoretical as well as practical training in different sections of the Institute. The students mainly comprised nominees serving in the Provincial Agricultural Departments.

Educational activity at the Institute was greatly intensified in 1958 with the granting of the status of the deemed university under the University Grants Commission Act of 1956, and the setting up of the postgraduate school for imparting instructions leading to M. Sc. and Ph. D. degrees in major disciplines.

The establishment of the Postgraduate School at the IARI was the result of a great deal of planning and hard work by Dr B. P. Pal, Dr Ralph W. Cummings of the Rockefeller Foundation and by the author of this book who removed many bottlenecks. This team was determined to build a centre of excellence which could impart training for M. Sc. and Ph. D. degrees of a quality that would be second to none anywhere in the world. Dr Pal and Dr Cummings made important contributions on the academic side. Dr Cummings also acted as the first Dean of the Postgraduate School. The contribution which this school has already made in producing nearly 2 400 M. Sc. and Ph.D. graduates, many of whom occupy important positions in the newly established agricultural universities and other organizations, is only too well known. The School also succeeded in laying down sound procedures and healthy academic traditions which provided a model for the agricultural universities.

## RESEARCH

The Institute in its long history of 72 years commenced research on a large variety of crops. As the nucleus of research developed, separate centres were established. Research on sugarcane, tobacco, potato and lac initially started at the IARI which led, in course of time, to the establishment of the Sugarcane Breeding Institute, Coimbatore; the Central Tobacco Research Institute, Rajahmundry; the Central Potato Research Institute, Simla; and the Indian Lac Research Institute, Ranchi. Research work on cotton was transferred to the Indian Central Cotton Committee in 1921 and on silk to the Silk Institute at Bhagalpur in Bihar. Work on Medical and Veterinary Entomology was started first at Pusa in 1920. The Sugar Bureau established in 1919 was transferred to the Institute of Sugar Technology, Kanpur,

in 1930. A post of Imperial Dairy Expert was created and a Dairy Section was located at Pusa. Later on the Imperial Institute of Animal Husbandry and Dairying (now the National Dairy Research Institute) was established at Karnal. In this manner from the parent Agricultural Research Institute a number of daughter institutions were brought into existence for the development of agriculture, fulfilling the hopes and aspirations of the founders of the Institute.

## Agricultural Extension

Till 1949, when the Ministry of Agriculture decided that the Institute should take more direct part in agricultural extension, it had practically no such activity. First the Institute organized the Delhi Intensive Cultivation Scheme in 19 villages. In 1959 the entire Kanjhawala Community Development Block comprising 56 villages was made available to the Institute. The programme of extension now covers the entire Delhi State.

## Growth of Divisions

The original five sections later developed into five Divisions. In 1945 the Division of Agricultural Engineering was added. In 1956 the Division of Horticulture was constituted for dealing with fruits and vegetables by transferring research work on them from the parent Division of Botany. In 1970 the Division of Horticulture was further split into two, comprising a Division of Horticulture and Fruit Technology and a Division of Vegetable Crops and Floriculture.

The Plant Introduction unit of the Division of Botany was separated from it in 1961 and formed into a Division. In 1966 another Division, that of Plant Physiology and Phytotron, was created out of the Division of Botany which was renamed as the Division of Genetics. The Seed Testing Unit in the Division of Genetics was developed into a Division of Seed Technology in 1968. In the same year a Nuclear Research Laboratory was set up with the general assistance of the UNDP (special fund) for affording research and training facilities for application of nuclear research techniques to agriculture.

In 1960 two more divisions, Agricultural Economics and Agricultural Extension, were created by separating these disciplines from the Division of Agronomy.

An All-India Soil Survey Scheme, started in 1956 within the Division of Soil Science and Agricultural Chemistry, later developed into All-India Soil and Land-Use Survey Organization in 1958, and which had been functioning like a Division of the Institute under the control

of a Chief Soil Survey Officer. The section of Microbiology in the Division of Soil Science and Agricultural Chemistry developed into a full-fledged Division of Microbiology in 1961, and the section of Soil Physics into the Division of Agricultural Physics in 1962. To look after the work of pesticides, synergists, adjuvants etc. the section of Plant Chemistry was given in 1966 the status of a full-fledged Division of Agricultural Chemicals. In the same year the Division of Biochemistry, originally a section in the Division of Soil Science and Agricultural Chemistry, was also established.

A section in the Division of Entomology, viz. Nematology, grew into a division in 1966.

In 1970 the Water Technology Centre was established, to deal with all aspects of water management leading to more effective use of water and land.

Thus within the Institute there are divisions based on subject disciplines, and there are centres like the Nuclear Research Laboratory and the Water Technology Centre, which serve several disciplines because they have specialized equipments and technical competence.

Till 1958 only three divisions were added to the original five of the Institute. The period between 1960 and 1970 showed a record of phenomenal growth—13 divisions and four regional research stations were added to the Institute.

In 1975 the Division of Plant Introduction and the All-India Soil and Land-Use Survey were separated from the Institute to become independent constituent directorates under the ICAR.

REGIONAL STATIONS

The Institute has 14 Regional Stations as listed below.

1 Regional Station, Pusa, Bihar
2 Regional Station, Kanpur, Uttar Pradesh
3 Regional Station, Sirsa, Haryana
4 Regional Station, Hyderabad, Andhra Pradesh
5 Regional Station (Vegetable Research), Katrain, Kulu Valley, Himachal Pradesh
6 Seed Research Products Station, Karnal, Haryana
7 Regional Station (Wheat Breeding), Wellington, Nilgiris, Tamil Nadu
8 Regional Station (Wheat Breeding), Indore, Madhya Pradesh
9 Regional Station (Wheat Breeding), Bhowali, District Naini Tal, Uttar Pradesh

10 Regional Station (Wheat Breeding), Tutikandi, Simla, Himachal Pradesh
11 Regional Station (Plant Pathological Research), Flowerdale, Simla, Himachal Pradesh
12 Regional Station (Horticulture), Jutog, Simla, Himachal Pradesh
13 Regional Station (Virus Research), Kalimpong, West Bengal
14 Regional Station (Virus Research), Poona, Maharashtra

Of these, the stations at Kanpur and Hyderabad were originally stations of the PIRRCOM (Project for Intensification of Regional Research in Cotton, Oilseeds and Millets) under the ICAR and were transferred to the IARI in 1966. The regional station at Pusa is the remnant of the original headquarters of the Institute at Pusa and was also known earlier as the Botanical Substation of the Institute. These regional stations serve the purpose of testing the research concepts and materials developed at the headquarters under different agro-climatic conditions. The Regional Stations at Hyderabad and Kanpur have also the Project Co-ordination unit of the All-India Co-ordinated Sorghum Improvement Project and the Pulse Improvement Directorate respectively.

## ALL-INDIA CO-ORDINATED PROJECTS LOCATED AT THE IARI

After the inception of the All-India Co-ordinated Projects of the ICAR for conducting research on certain aspects on national scale, the IARI was the first institute where the Project Co-ordination Units and the Project Co-ordinators of some of these co-ordinated projects were located. At present the Project Co-ordinators and the co-ordination units of the following projects are located at this Institute :

1 Project Co-ordinator, Pulses
2 Project Co-ordinator, Maize
3 Project Co-ordinator, Open Tubewells
4 Project Co-ordinator, Floriculture
5 Project Co-ordinator, Soil Physical Conditions
6 Project Co-ordinator, Vegetable Crops
7 Project Co-ordinator, All-India Co-ordinated Research Project on Soil Physical Conditions
8 Project Co-ordinator, All-India Co-ordinated Research Project on Algae

The post of the Project Co-ordinator (Wheat) was upgraded to that of Project Director in April 1978. The Project Director, All-India

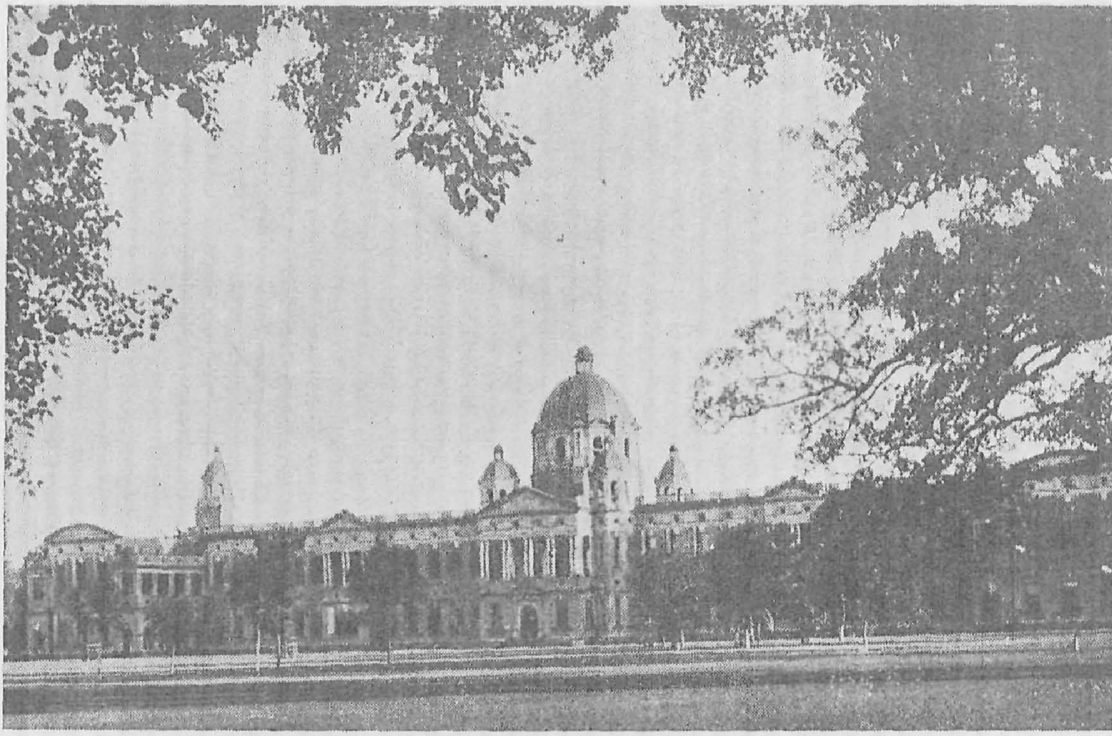
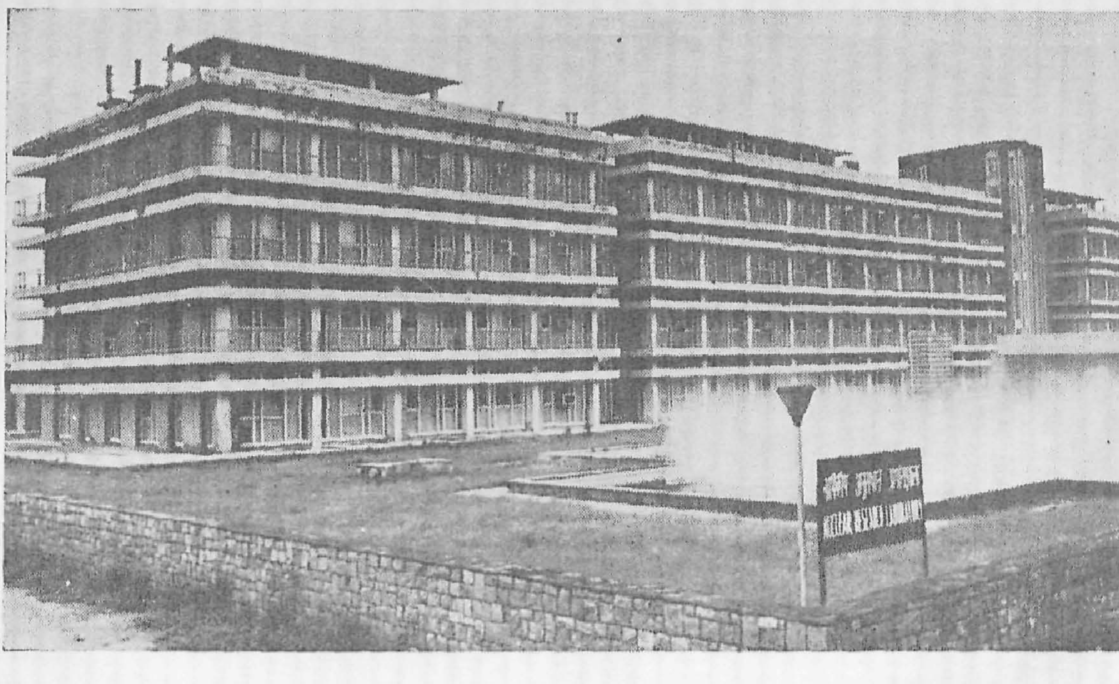


Fig. 7. Indian Agricultural Research Institute's old building at Pusa, Bihar

Fig. 8. Nuclear Research Laboratory of the IARI, New Delhi



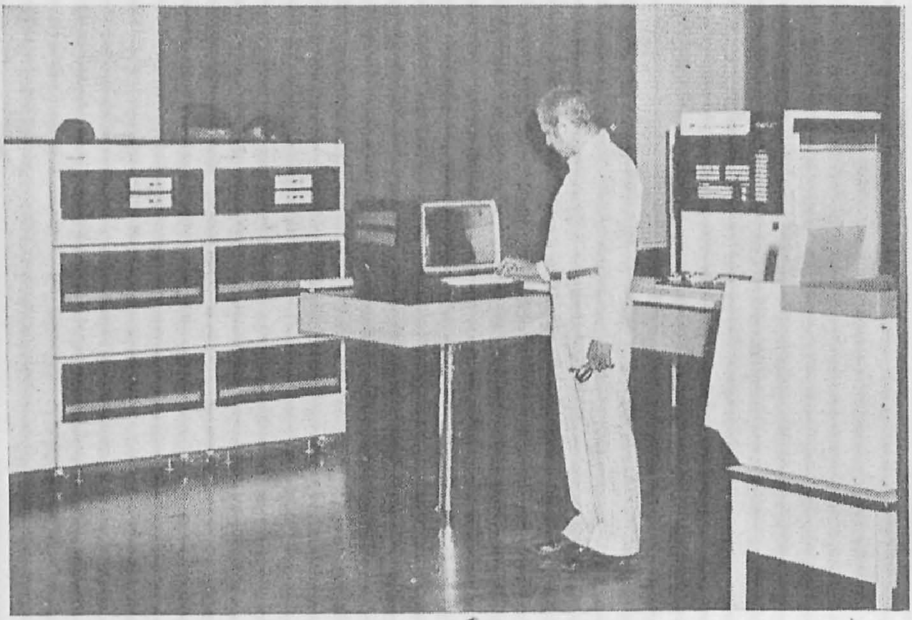
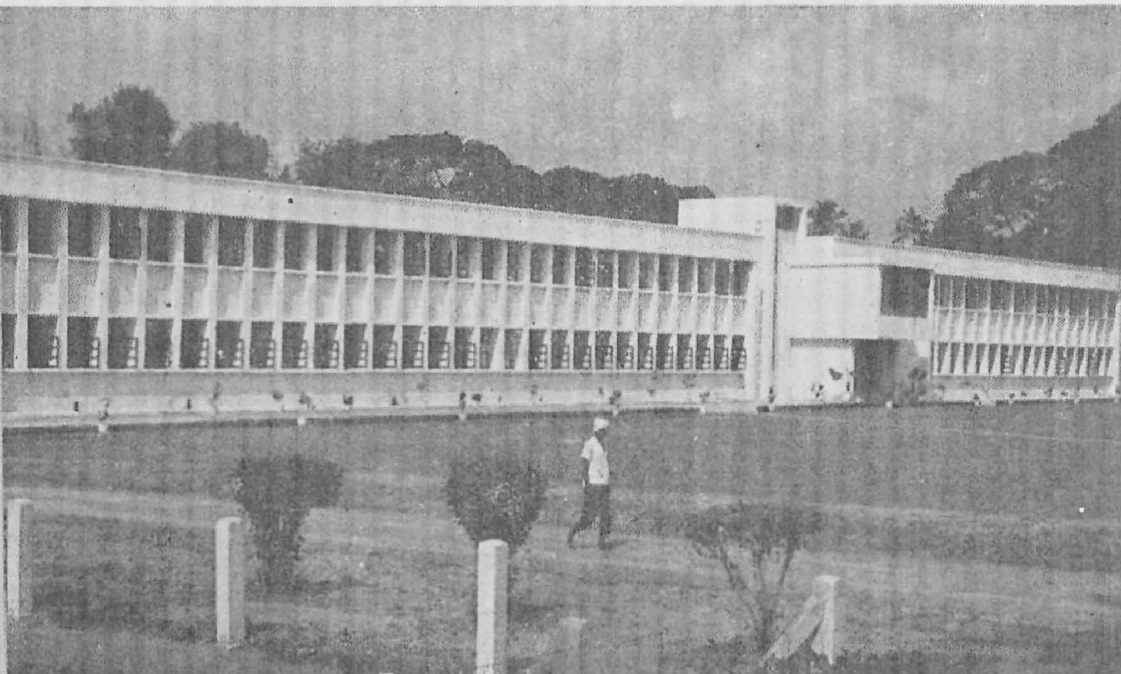


Fig. 9. The Computer Centre of the Indian Agricultural Statistics Research Institute, New Delhi

Fig. 10. Sugarcane Breeding Institute, Coimbatore, Tamil Nadu



Co-ordinated Pulse Improvement Project, is also located at the Institute's Regional Station at Kanpur and he also functions as its Head.

FACILITIES AVAILABLE

The Institute has model laboratories where a large number of sophisticated expensive equipments are available for advanced research. The Nuclear Research Laboratory, established in the Institute in 1968-69 under a UNDP Special Project, has a large array of equipments for research on the application of nuclear tools in agriculture. Its facilities include an electron microscope, gas chromatography equipment, amino acid analyser, etc. The Institute has also built up over the years what may be termed as the 'National agro-biological collections', which are very useful not only to the research workers of the Institute but also to those of other institutions. These include : (*i*) the National Pusa Insect Collection whose foundations were laid by distinguished entomologists like Lefroy and Fletcher; (*ii*) the Herbarium Cryptogamae Indiae Orientalis, comprising extensive *exciccati* collections of disease-causing and other economic species of fungi, and the National Type Culture Collections, including living collections of fungi, bacteria, some viruses and an antisera bank for detection and classification of viruses; (*iii*) a large collection of rhizobium cultures; (*iv*) extensive germplasm collections, comprising genetic stocks of a wide range of crop plants and other plants, i.e. 'Working Collections'. The experimental field of the Institute is maintained and looked after by the Farm Operations Service Unit (earlier known as the Department of Farm Operations and Management).

ACHIEVEMENTS

Since its establishment in 1905, the Institute has built up a well-deserved reputation for relevance and excellence in the field of agricultural research and education. A turning point in the history of this Institute came in the early 1960's when it was decided to give Indian agriculture a new direction, transforming it from subsistence to scientific and from extensive to intensive one. It is during this period that the high-yielding varieties programme in crops like wheat, sorghum, maize and millets was initiated at this Institute in collaboration with the Rockefeller Foundation. Also, the concept of multiple and relay cropping was developed by the scientists of this Institute so that the production potential of India's vast irrigated lands and favourable conditions for crop growth throughout the year could be fully exploited. The country

has one of the finest production technologies in the world in crops like wheat, sorghum and pearlmillet. Also, new high-yielding varieties of rice, combining a short maturity duration with good grain quality, are being developed which should find an important place in the wheat-rice rotation in the non-traditional rice-growing States of northern India. The significant results of research are described in the chapter 'Progress of Research in Crop Sciences'.

The IARI has been a very important centre of basic research in various biological sciences relating to agriculture. The emphasis has been on mission-oriented basic research, the results of which could very usefully promote applied research and direct the latter on gainful lines.

Some of the items of basic researches carried out at this Institute are briefly enumerated below.

1 Genetical research on mode of inheritance of disease and pest resistance and other economic characters in a wide range of crops (wheat, barley, maize, sorghum, millets, linseed, pigeonpea, vegetables)
2 Mutation research for studying, accelerating and directing the mutation phenomena by physical and chemical means, including radio-isotopes
3 Speciation in evolutionary origin of crop plants (oil-yielding Indian mustard, okra, forage grasses belonging to *Panicum*)
4 Cytogenetical studies on wheat, rapeseed and mustard, sesame, forage grasses, including monosomic analysis
5 Research on induced polyploidy in a wide range of crops
6 Research on *Triticale*
7 Research on biometrical genetics, leading to improvement of plant-breeding methodology
8 Biophysical and biochemical basis of grain quality and nutritive value in wheat, maize, grain sorhgum and pulses
9 Basic research on foodgrain irradiation
10 Use of radio-isotopes as tracers for studies on pattern of rooting in crops, on uptake of plant nutrients and on movement of water through soils
11 Physical and chemical features (including clay minerals) of the major soil types in India and their nutrient status in relation to major plant nutrients and micronutrients
12 *Basic research on biogas (methane and other gases generated* from animal dung)

13 Basic studies on soil test-crop response correlationship
14 Research on nitrogen-fixing Rhizobia and other micro-organisms, including blue-green algae
15 Research on soil physics in relation to soil structure, movement of moisture, gases and nutrients through soil, and crop production
16 Physiological analysis of yield under irrigated and unirrigated conditions in wheat, cotton, sunflower, pulses and some other crops
17 Physiological research on tolerance or resistance to drought, salinity and other stress conditions
18 Photosynthetic efficiency in relation to crop yield
19 Basic studies on the physiological races and biotypes of disease-causing fungi and bacteria, including the rusts and loose smut of wheat, rusts of linseed, wilt diseases of linseed and pigeonpea
20 Epidemiological studies, including the geographic movement and spread of disease inoculum, especially in relation to the rust diseases of wheat
21 Basic studies on the wilt disease of the pulse crops—Bengalgram and pigeonpea
22 Unravelling the aetiology of the 'malformation' disease of mango, which is very seriously affecting mango orchards especially in north India
23 Research leading to the demonstration that a strain of the tobacco mosaic virus is associated with the 'root-wilt' disease complex of coconut, which is very serious in central Kerala
24 Research on insect parasitology, leading to the identification of useful parasites and predators of insect pests
25 Research on insect physiology, especially in relation to the formulation of synthetic diets for rearing insects to assist in programmes for developing insect-tolerant/resistant varieties, and also on pheromones
26 Research on insect pathology for controlling pests by the use of fungal, bacterial and viral pathogens
27 The concept of the 'biometer' involving climatological and epidemiological studies on the development of population of insect pests
28 The effect of sun-spot activity on locust population in relation to the possible use of non-insect predators for locust control
29 Biological control of snails.

## Higher Education and Training

The IARI played a very major role in preparing and providing the nation with trained manpower just when it was needed the most. Ever since its establishment, in 1905, the IARI has functioned as a national centre for postgraduate training in agriculture. In 1958 the pattern of instruction at the IARI was reorganized when the present Postgraduate School was set up and the Institute was declared as a 'deemed university' by the Government of India on the recommendation of the University Grants Commission and authorized to award its own M. Sc. and Ph. D. degrees. The IARI was the first agricultural education institution in the country to adopt, with suitable modifications, the modern course-credit and internal assessment systems which have been acclaimed the world over, and to prescribe course work, in addition to a high-quality research thesis, for the M. Sc. and Ph. D. programmes. The IARI today enjoys the reputation of being the hallmark of quality, and considered amongst the world's best centres, not only in the field of agricultural research but also in postgraduate education. Between 1958 and 1976 the IARI has trained about 1 025 candidates for the Ph. D. degree and about 1 100 for the M. Sc. degree in 15 major disciplines of agricultural research. These young, well-trained scientists are manning important research and educational positions in the agricultural universities and the Central research institutes. Since 1965 the Postgraduate School of the IARI has functioned in close co-operation with the Institute of Agricultural Research Statistics (IARS) located on an adjoining campus. The IARI has taken the responsibility of organizing courses in statistics and allied subjects for IARS (now IARSI), which now grants M. Sc. and Ph. D. degrees in agricultural statistics also. The computer facilities located at the IARS are available to the staff and postgraduate students of the IARI also.

In addition to the course leading to the M. Sc. and Ph. D. degrees, the Institute is also called upon to organize a number of short-term (6-week to 6-month) training courses in co-operation with national and international institutions and agencies, e.g. the Food and Agriculture Organisation of the United Nations (FAO), International Atomic Energy Agency (IAEA), the United Nations Development Programme (UNDP) and countries like Sweden, Denmark and the Netherlands, etc. Thus the IARI is a major, and leading, institution in the country for postgraduate education and training (including trainers' training) in agriculture and is indeed an asset to the nation.

EXTENSION EDUCATION

Since 1949 the Institute has been operating an extension education programme in the rural areas of the Union Territory of Delhi. In 1965 this endeavour was further intensified by locating a 'Production Unit', comprising specialists in the various fields of agricultural science, in the Division of Agricultural Extension which now concertedly spearheads this activity, which provides an effective clinical outlet for the transfer of modern agricultural technology to the rural areas and a feed-back mechanism so vital for the sound progress of both research and development. The programme includes the conducting of numerous demonstrations on farmers' fields, organizing drives and campaigns for specific purposes and holding *Krishi Vigyan Melas* (Farmers' Fairs) in co-operation with the Delhi Administration. Currently the Institute is operating an intensive programme of operational research for total agricultural development in a selected group of villages in the Delhi Territory.

CONTRIBUTIONS OF DIRECTORS

Since its early years the Institute has had a galaxy of Directors who not only looked after the day-to-day management of the Institute and contributed to its growth, but also made a mark in their respective fields of specialization. Mr E. J. Butler, who was Director during 1909-10, 1910-11 and 1918-19, was a distinguished mycologist who laid the foundations of the impressive collection of fungi. Mr W. M. Rae, who was the Director in 1923-24, 1925-26, 1928-29 and 1931-32, was also a distinguished mycologist. Mr B. A. Keen, who was Director during 1930-31, was a well-known agricultural chemist and he had made several contributions in the field of Soil Science and Agricultural Chemistry. Mr W. H. Harrison, Director during 1921-22, 1922-23, 1923-24, 1925-26, 1927-28 and 1929-30, was a distinguished soil scientist. Mr S. Milligan, who was the Director during 1919-1922, was a well-known agronomist who made important contributions to the study of the agronomic requirements of several crops. Mr F. J. F. Shaw, Director of this Institute during 1928-30 and 1932-35, was a well-known economic botanist of his period, who made important contributions to wheat breeding by evolving several improved varieties of the then famous Pusa wheats.

Rao Bahadur B. Vishwanath, a distinguished soil scientist, was the first Indian Director of the Institute from 1935 to 1944. Dr Hem Singh Pruthi, who was the Director in 1944-45, was an eminent entomologist

with several enduring contributions in applied entomology. He subsequently became the first Plant Protection Adviser to the Government of India. Dr J. N. Mukherjee, Director during 1946-51, was an eminent soil scientist, who contributed a great deal towards the growth of the discipline of soil science and agricultural chemistry. Dr B. P. Pal, who was the Director from 1952 to 1965, is an internationally famous plant breeder who continued the work of Mr Albert Howard and Mr F. J. F. Shaw in wheat improvement, thanks to which our country has now the largest and the best-organized wheat-improvement programme in the world He is also a distinguished rosarian with several new varieties of roses to his credit. Besides his contributions as a scientist, Dr Pal also worked hard for the growth of the Institute and it was during his directorship that the Institute was declared a deemed university in 1958 and empowered by the UGC to confer M. Sc. and Ph. D. degrees to the students admitted to its Postgraduate School. Dr Pal later became the first Director-General of the re-constituted ICAR in May 1965. Dr Pal was the first Indian agricultural scientist to receive the Fellowship of the Royal Society of England in 1970.

Dr A. B. Joshi, who was the Director from May 1965 to July 1966 and again from June 1972 to January 1977, is also a well-known plant breeder, with several important contributions in the field of improvement of wheat, cotton and oilseeds. His second tenure as the Director of the Institute from 1972 to 1977 was marked by the important contribution of drawing up of an ambitious Master Plan for the redevelopment of the campus of the Institute, involving extensive pulling down of the old outmoded buildings and the construction of modern structures in their place. The Master Plan is being implemented in a phased manner.

Dr M. S. Swaminathan, who was the Director of the Institute during 1966-72, is a plant breeder of international renown. One of his most important contributions is the leadership he provided in the early 60's in the improvement of the dwarf Mexican wheats introduced in that period, which led to their large spread in the major wheat-growing areas of the country and the record yields first achieved in 1967. He is also well known for his contributions in mutation breeding and for his cyto-genetical researches. Dr Swaminathan became the Director-General of the ICAR in 1972, after the retirement of Dr Pal. During his period as Director of the Institute, there was a remarkable growth in the research activities as well as the staff strength and facilities. Dr Swaminathan is the second Indian scientist to have been

awarded the Fellowship of the Royal Society.

Dr H. K. Jain, who succeeded Dr A. B. Joshi in February 1977, is a geneticist who believes that the key-word in the transformation of Indian agriculture from subsistence to scientific is genetic reconstruction of crop plants associated with improved agronomic management. Apart from his basic work in the field of genetic recombination, Dr Jain has been making a major contribution in preparing new blueprints for India's crop plants of the future, which will be highly efficient in utilizing water, fertilizer, solar energy and other inputs.

CHAPTER 16

# RESEARCH INSTITUTES ON SUGARCANE

## SUGARCANE BREEDING INSTITUTE, COIMBATORE (1912)

THE Sugarcane Breeding Institute was started at Coimbatore in 1912, as a breeding station for evolving improved varieties of sugarcane for the subtropical areas of India. The breeding of varieties for the tropical belt of the country was also taken up from 1926. Initially the Station was under the administrative control of the Director of Agriculture, Madras, and funded by the Government of India. The Station was taken over by the Government of India in 1924 as a part of the then Imperial Agricultural Research Institute, Pusa. From 1950 it came under the direct control of the Union Ministry of Food and Agriculture. With the change in the status of the Station into an Institute, the designation of the Head of the Institute was also changed from the Government Sugarcane Expert to that of Director. The Institute became part of the ICAR from April 1969. The Institute celebrated its Golden Jubilee in 1962 and Diamond Jubilee in 1972. The last 50-year period could be hailed as the golden era in sugarcane breeding.

The Regional Centre at Karnal (Haryana) was established in 1932 for subtropical testing and the centre at Cannanore (Kerala) in 1962 to maintain mosaic-free germplasm of sugarcane. In 1962 subcentres were started at Lucknow (Uttar Pradesh) and Motihari (Bihar) for varietal testing, but were closed in 1969 and 1976 respectively.

Though the Institute was housed initially in small buildings, a spacious building with adequate laboratory facilities was provided in 1958. The Institute was equipped with a radio-isotope laboratory in 1963, a $^{60}$Co Gamma Cell in 1971, a new biological control laboratory and aerated steam therapy unit in 1976, and a tissue-culture laboratory in 1977. Agronomy liaison units to work at factory sites and an extension wing were formed in 1978. The statistical wing got strengthened with the addition of a mini-computer and programming equipment in 1978. The Institute has a total area of 83 ha. Two new bore wells were sunk and energized in 1978. Proposals for acquiring an additional land area of 10 ha are being finalized. Additional new buildings for the main Institute and the subcentres are likely to be completed by 1979.

The main functions of the Institute are to breed improved varieties

of sugarcane for the sugarcane-growing areas of the Indian Union; to conduct fundamental research on the genetic, cytogenetic, physiological, pathological, entomological and agronomic aspects of sugarcane in relation to breeding; to impart postgraduate training in sugarcane breeding, botany, etc.; and to disseminate information on varieties and related aspects to the sugarcane growers and sugar factories.

The Institute has plant breeding, genetics and cytogenetics, plant physiology and biochemistry, agricultural chemistry and soil science, entomology, pathology, agronomy and farm management divisions, and statistics and extension sections. Adequate library and documentation facilities, photography and artist wings, meteorological observatory and a central exhibition are also provided. The Institute is collaborating in research investigations under the All-India Co-ordinated Research Project on Sugarcane.

ACHIEVEMENTS

Before the release of Co varieties, the indigenous sugarcane varieties grown in the country were very poor in yield, giving not more than 15 tonnes/ha. As such, India had to import large quantities of sugar from Jawa. Coimbatore was chosen as the venue for breeding work in India since sugarcane flowered and set seeds freely under its climatic conditions. This Institute has been the main source of improved varieties of sugarcane throughout the country except for the limited programme in Bihar and Karnataka.

Nearly 2 000 Co varieties have been released so far and the elite ones were selected for different agro-climatic conditions of the country from time to time. These include high-yielding Co canes like 'Co 281', 'Co 285', 'Co 290', 'Co 312', 'Co 419', 'Co 740', 'Co 975', 'Co 1148', 'Co 1158', 'Co 62175' and 'Co 6304', as well as early-ripening, sugar-rich varieties like 'Co 527', 'Co 658', 'Co 997', 'Co 1136', 'Co 62714', 'CoC 671', 'CoA 7601', 'Co 6806' etc. Varieties were also evolved for resistance to red-rot, smut, borer pests and also to adverse environmental conditions as drought, floods, frost, water-logging and salinity. Recently attention has been devoted to the evolution of short-duration varieties for harvest at 240 days and 'CoC 671', 'CoA 7601', 'Co 7201', 'Co 7704' and 'Co 7712' appear to hold promise. The breeding for horizontal resistance to red-rot has also made much progress. 'Co 419' and 'Co 740' have been acclaimed as the wonder canes of India.

The improved varieties released by the Institute have made great impact in several spheres. The sugarcane growers all over the country could improve the tonnage and increase their income. As a result of

the popularity of the Co canes, over 95% of the sugarcane area in the country is saturated with improved varieties. The record yields of 335 tonnes/ha in Uttar Pradesh in 1970 and 464 tonnes/ha in Maharashtra in 1973 obtained in Prize Yield Competitions emphasize the potentialities of improved varieties in achieving a further break-through in production. The country has witnessed a phenomenal expansion in area and production of sugarcane from 1950 to 1978. The area under sugarcane increased from 1.7 million ha to 2.9 million ha. The number of sugar factories rose from 138 to 271. Cane production rose from 70 to 160 million tonnes and national sugar production from 1.2 to 6.5 million tonnes. The Coimbatore sugarcane varieties have significantly contributed to this Sugar Revolution in India. Now the factories start early crushing, and recovery of sugar has also improved. In a recent survey conducted in the USA on the input-output ratio and also the cost-benefit ratio through research in crops, it was revealed that the sugarcane research work conducted at the Sugarcane Breeding Institute, Coimbatore, in evolving the improved hybrid Co varieties has given the maximum results.

The Coimbatore cane varieties such as 'Co 281', 'Co 290', 'Co 312', 'Co 413', 'Co 421', 'Co 419', 'Co 527' etc. have been much in demand in many foreign countries. Their cultivation was taken up on a substantial scale in over 26 countries, especially in West Indies, Mexico, the USA, South Africa, Hawaii and Australia. Though none of the high-quality exotic varieties could be grown successfully in any part of India, the performance of Coimbatore-bred varieties in foreign countries is an interesting phenomenon. However, exotic types such as 'POJ 213', 'POJ 2878', 'Q 63' etc. have been widely used as parents in hybridization work at Coimbatore.

The breeding programme depends solely on the ingenuity of the sugarcane breeders and their successful exploitation of the germplasm. Sugarcane is probably the unique crop wherein the wild species has played a crucial role in crop improvement, and most of the Co canes are derivatives of trispecific hybrids involving *S. officinarum*, *S. barberi* and *S. spontaneum*. The Institute has the largest world collection of germplasm of 2 800 genetic stocks of *Saccharum* and related genera besides commercial varieties of Indian and exotic origin. The *spontaneum* Expedition Scheme was launched in 1956, when the International Society of Sugarcane Technologists' 9th Conference was held at the Institute. Under the PL-480 scheme, from 1963 to 1971 breeding for resistance and improving the agronomic potential of exotic

canes was carried out using several new clones of *S. spontaneum* and 133 elite clones (Indo-American clones) supplied to the USDA. These IA clones are also being used at Coimbatore in breeding.

A limited fluff supply was made as early as in 1930 to Bihar. The programme for supply of fluff (hybrid seed) has been intensified since 1974 by establishing a National Hybridization Garden, in which all the State research stations participate to effect the desired crosses. In 1978 a quantity of 27 kg of fluff capable of yielding 2 million seedlings was distributed to 15 centres in India for generating a broad spectrum of variability.

This Institute has been a pioneer in the world in attempting distant hybridization with several related genera, and particularly those with *Sorghum* or *Zea* have been acclaimed as great achievements in plant hybridization. In recent years the *Saccharum* × sweet sorghum crosses have been taken up. Notwithstanding the peculiar features of the sugarcane plant, ingenious methods and techniques have been devised to suit the crop which enabled us to achieve rapid strides in the varietal front in the last 50 years.

The fundamental research support to carry on the task of providing potentially high-yielding, high-quality and resistant varieties was aided by the various disciplines in the Institute. Mention may be made of the artificial flower induction and synchronization of flowering by the Physiology Section, selection for red-rot and smut resistance and development of heat therapy techniques for disease control by Pathology Division, improving the juice quality and fibre attributes of varieties by the Chemistry Division, pest resistance and control methods by the Entomology Division, chromosomal basis and chromosome manipulation or genetic engineering and mutation by the Cytogenetics Division, and ratooning attributes by the Agronomy Division. The scope of these divisions has been enlarged recently, as a result of which work on biological control, biometrical, mutation and tissue-culture techniques, experimental designs for efficient evaluation of genotypes, post-harvest technology, drought resistance and evolution of new ideotypes in sugarcane have been intensified.

### Contributions of Directors

*Dr C. A. Barber* (1912-18). Dr Barber's monograph on the *Classification of Indian Canes* is a monumental contribution. Barber initiated crosses between *Saccharum officinarum* and *S. spontaneum*. Varieties 'Co 205', 'Co 210', 'Co 213' and 'Co 214' were evolved as a result of

his work. His contribution to sugarcane botany and breeding earned international recognition.

*Dr T. S. Venkatraman* (1919-42). He is known as the wizard of sugarcane breeding. He undertook massive hybridization of trispecific combinations involving *S. officinarum*, *S. barberi* and *S. spontaneum*, besides intergeneric crosses of *Saccharum* with bamboo, sorghum and maize. His sugarcane-sorghum crosses were acclaimed as revolutionary achievements in artificial plant-hybridization experiments. In recognition of his work he was knighted by the Government of India. He was a breeder of great acumen, and bred several celebrated varieties of sugarcane. 'Co 205', 'Co 281', 'Co 290', 'Co 312', 'Co 313', 'Co 419' and 'Co 421' were bred by him. He also showed that expenditure on sugarcane breeding in India was a very profitable investment which led to a successful sugar industry.

*Mr N. L. Dutt* (1942-58). He was associated with sugarcane breeding for over three decades, and was responsible for the release of the first wonder cane of India, 'Co 419', and later of 'Co 453', 'Co 475' and 'Co 449'. He initiated studies on sugarcane cytology, photology photoperiodism. The *spontaneum* expedition was organized by him in 1946. He established a World Collection of Surgarcane Germplasm. His book *Coimbatore Canes in Cultivation* is an authoritative work.

*Dr N. R. Bhat* (1958-61). He regionalized the hybridization work and put selection work on sugarcane on a firm footing so that it could meet the needs of the agro-climatic conditions of States in India.

*Dr J. Thuljaram Rao* (1961-79). He was associated with sugarcane breeding for nearly four decades. He was responsible for the release of 'Co 997', 'Co 1148', 'Co 1158', 'Co 6304', 'Co 62174', 'Co 62175' and 'Co 771/', which are very popular. He has contributed to the knowledge of flowering, anatomy and taxonomy of sugarcane.

*Dr S. S. Shah* (1970-75). He contributed to biometrical approach to sugarcane breeding and selection criteria.

## INDIAN INSTITUTE OF SUGARCANE RESEARCH, LUCKNOW (1952)

The Indian Institute of Sugarcane Research was founded on 16 February 1952 under the administrative control of the Indian Central Sugarcane Committee and was placed under the technical control of the Director, Indian Institute of Sugar Technology, Kanpur (later renamed National Sugar Institute, Kanpur). A beginning was made by providing four sections, comprising Agronomy, Entomology, Mycology

and Agricultural Engineering. On 1 January 1954, the Government of India, Ministry of Food and Agriculture, took over the Institute from the Indian Central Sugarcane Committee and appointed a separate Director. Dr B. K. Mukerji was the founder Director of the Institute. He took over on 23 November 1954. In 1956 two more sections of Agricultural Chemistry and Soil Science and Physiology were added to the Institute, besides the *gur* and *khandsari* section. The latter was transferred to the National Sugar Institute, Kanpur, in 1959. The Institute owned an undulating commercial farm of about 150 ha with irregular fields. It had to be reshaped into uniform and levelled fields with pukka channels and metalled roads. It had been partially mechanized and provided irrigational facilities by installing four deep-bore tube-wells.

On 1 April 1969 the Government of India transferred the Institute to the ICAR. Since then the Institute has been strengthened and equipped to tackle the problems facing the country and the industry more efficiently. In 1970, Botany and Breeding Section was added to the Institute to develop varieties for subtropical India, thus enlarging its research frontier and responsibilities. Two more sections—Biochemistry and Agricultural Economics and Statistics—were initiated during the Fifth Five-Year Plan. A Communication and Training Centre has also been added recently to meet the need for extension and advisory work. Isotope and residue analysis laboratories are the latest additions.

Under the able leadership and guidance of three Directors of the Institute, viz. Dr B. K. Mukerji, the late R. R. Panje and the present Director, Dr Kishan Singh, the Institute has carried out researches which are useful to the sugar industry and the cane growers.

ACHIEVEMENTS

*Companion cropping.* The Institute has developed a technique of companion cropping in which dwarf wheat, potato, *toria*, berseem, pulses and sugarbeet are raised in the inter-space of two rows of autumn-planted sugarcane without any significant adverse effect on the yield of either of the two companion crops.

A staggered-row technique of sugarcane planting has been developed. In this technique sugarcane is planted in 30-150 cm row spacing with 150 cm space for the inter-crop. By this technique it has now been possible to grow 7 rows of wheat in place of 6 in the conventional method of planting, and the number of cane rows remain the same. It results

in higher yield of companion crop. A wheat seed-drill and spraying machine have also been developed.

A technique known as the IISR polyethylene nursery system of sugarcane planting has been evolved to overcome difficulties in germination. In this technique 150-cm wide seed-beds are prepared, on which 3 bud setts are laid side by side horizontally with buds on sides after dipping them in 0.25% solution of aretan. Covering the setts lightly with about 1-cm fine soil layer, the bed is irrigated. When the soil gets soaked, a transparent 300-gauge polyethylene film is unrolled over the bed. For 150-cm wide bed, 3-m-wide polyethylene is required and the ends of the film are tucked under the soil, making it air-tight and leaving it loose in the centre, touching the bed surface. The width of the bed depends upon the width of the polyethylene and it should be about 30 cm less than the actual width of the film. The buds start germinating within 4-6 weeks even in cold winter months, and a germination as high as 80-85% has been recorded. By following this system young cane crops can be manoeuvered through severe climatic stresses like drought and low winter temperatures, and crop rotations can be intensified.

*IISR deep-furrow-cum-trash vein system of planting.* The IISR deep furrow-cum-trash vein system f sugarcane culture has helped in tiding over the evil effects of moisture-stress conditions caused by non-availability of irrigation water due to irregular flow of canals. In this system the cane is planted about 20 to 25 cm deep in furrows and is covered lightly with 4-5 cm fine soil covering. On completion of germination in about 5-6 weeks and as the warm weather sets in, some more soil from sides of the furrow is put in the furrow and the furrows are filled with cane trash. The trash should be taken from a disease- and pest-free field of previous year's sugarcane crop. When the primary shoot attains on an average 2-3 tillers, more trash should be filled up in the furrows to form a thick blanket. This ensures effective protection against loss of moisture through evaporation and suppresses the growth of weeds. In subsequent inter-culture and irrigation the soil falls into the furrows and with the outbreak of monsoon the furrows become almost flattened and the trash finally turns into a good compost by decay during the rainy season. The roots which emerge from deep-placed subsoil provide a firm anchorage against lodging to the clumps during rainy season.

*IISR-8626 technique of planting sugarcane.* In north India a fairly large area of sugarcane is planted late after harvest of *rabi* crops.

Under such a situation the cane is handicapped by poor tillering, resulting in poor yields and inferior juice quality. The IISR-8626 technique of planting sugarcane evolved by the Institute has shown promise to ameliorate the problem of quality and quantity of late-planted cane. The technique consists of vertically planted, pre-germinated long top setts in fully filled, fertilized and irrigated, 45-cm deep trenches. The technique has shown very high production potential. But the disposal of left-over cane after removal of the pre-grown long top setts and high cost involved in digging deep trenches are the obstacles in its adoption on commercial scale.

*Control of sugarcane flowering.* On flowering the growth of cane stalk ceases and the leaves become narrow and short in size. In the early part of the crushing season the flowered cane stalks register slightly superior juice quality in comparison with unflowered cane, but with the advancement of season the position reverses, rendering the cane inferior both in quality and quantity by March and later. Researches carried out at this Institute have made it possible to suppress the flowering almost completely by foliar spray of paraquat, diquat and pentachlorophenol chemicals in the second fortnight of September. Inhibition of flowering manually by defoliation has also been achieved.

*Ripening of sugarcane.* Foliar application of Cycocel and Polaris produced a significant difference in the juice quality 50 to 70 days after spray of the chemical in Nellikuppam. At Balrampur also the beneficial effect of the chemical was perceptible but it was not significant. Further studies are in progress to investigate the mode of action and residue analysis of the chemicals.

*Three-tier seed programme.* Heat therapy of cane is known to eliminate some of the important seed-piece-transmissible pathogens such as those causing RSD and GSD and markedly reduce red-rot and smut. The cane crop raised through this technique produces healthy crop. Plant-protection measures are necessary to check secondary infection. In hot-air treatment the seed cane is kept at 54°C for 8 hr, whereas in moist-hot air the time can be reduced to 3-4 hr. It is an effective way to prolong the commercial life of a variety. Therefore the Institute has drawn up a comprehensive three-tier seed programme. It has been introduced in a number of States and adopted by many sugar factories.

*Biological control of sugarcane pests.* Wasps and flies which are parasitic on sugarcane-borers in other countries have been imported through the Commonwealth Institute of Biological Control, Bangalore, and are being tested in India.

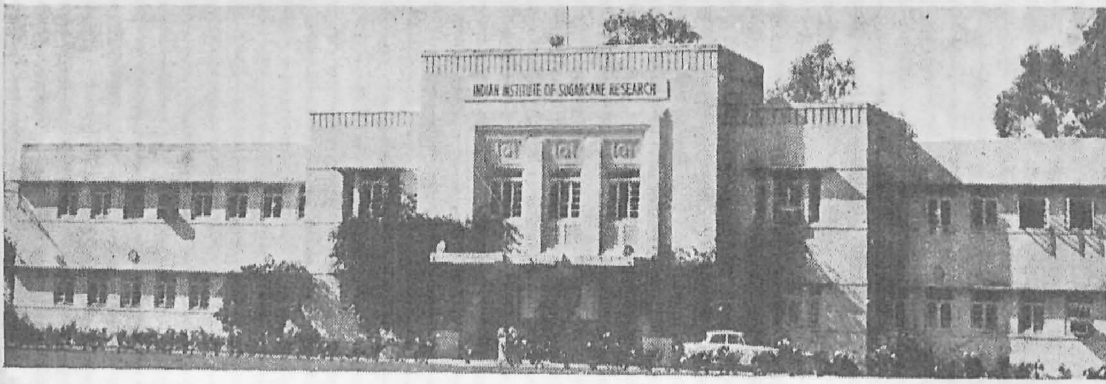
Surveys of insect population associated with sugarcane crop have been conducted. Much information has been obtained on the behaviour of insect pests in different areas as well as on some potentially useful parasites. In 1958 and 1961 a parasite called *Isotima javensis* Rohw. was collected from Muzaffarnagar area of Uttar Pradesh and introduced in Tiruchirappalli and Tanjore Districts of Tamil Nadu. It is now keeping down top-borer incidence in these areas. Another promising tachinid fly, *Sturmiopsis inferens* Tbs., has been found highly parasitic on shoot-borer, *Chilo infuscatellus* Snell., in some parts of Orissa State and in Coimbatore area of Tamil Nadu. Efforts are being made to mass-breed this parasite in the laboratory for testing its efficacy against the stalk-borer under field conditions in north India. The work on biological control has recently been further intensified by opening 5 more centres at Golagokarnnath, Captainganj (Uttar Pradesh), Dimapur (Nagaland), Pravaranagar (Maharashtra) and Rudrur (Andhra Pradesh).

An all-India co-ordinated research project on two major crops of sugar, i.e. sugarcane and sugarbeet, has been introduced by the ICAR with headquarters at the IISR, Lucknow, since 1970. The co-ordinated research programme is now running at 14 main centres and subcentres each for sugarcane and sugarbeet in the major sugarcane/sugarbeet-growing States of India. This programme has given impetus to regional problems, needing co-ordinated research efforts for their solution. The co-ordination unit of sugarbeet has been shifted to the Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, since September 1976.

Besides, an all-India co-ordinated Foundation Seed Programme for Sugarcane is also running at Lucknow, Shahjahanpur, Jagadhari, Jullundur, Motihari, Bethuadhari, Sehore and Pravaranagar. The work under the programme is co-ordinated by the Institute's co-ordination unit.

Fig. 11. Co '62174'—vigorous growing, popular, early maturing sugarcane variety of Tamil Nadu

Fig. 12. Indian Institute of Sugarcane Research, Lucknow



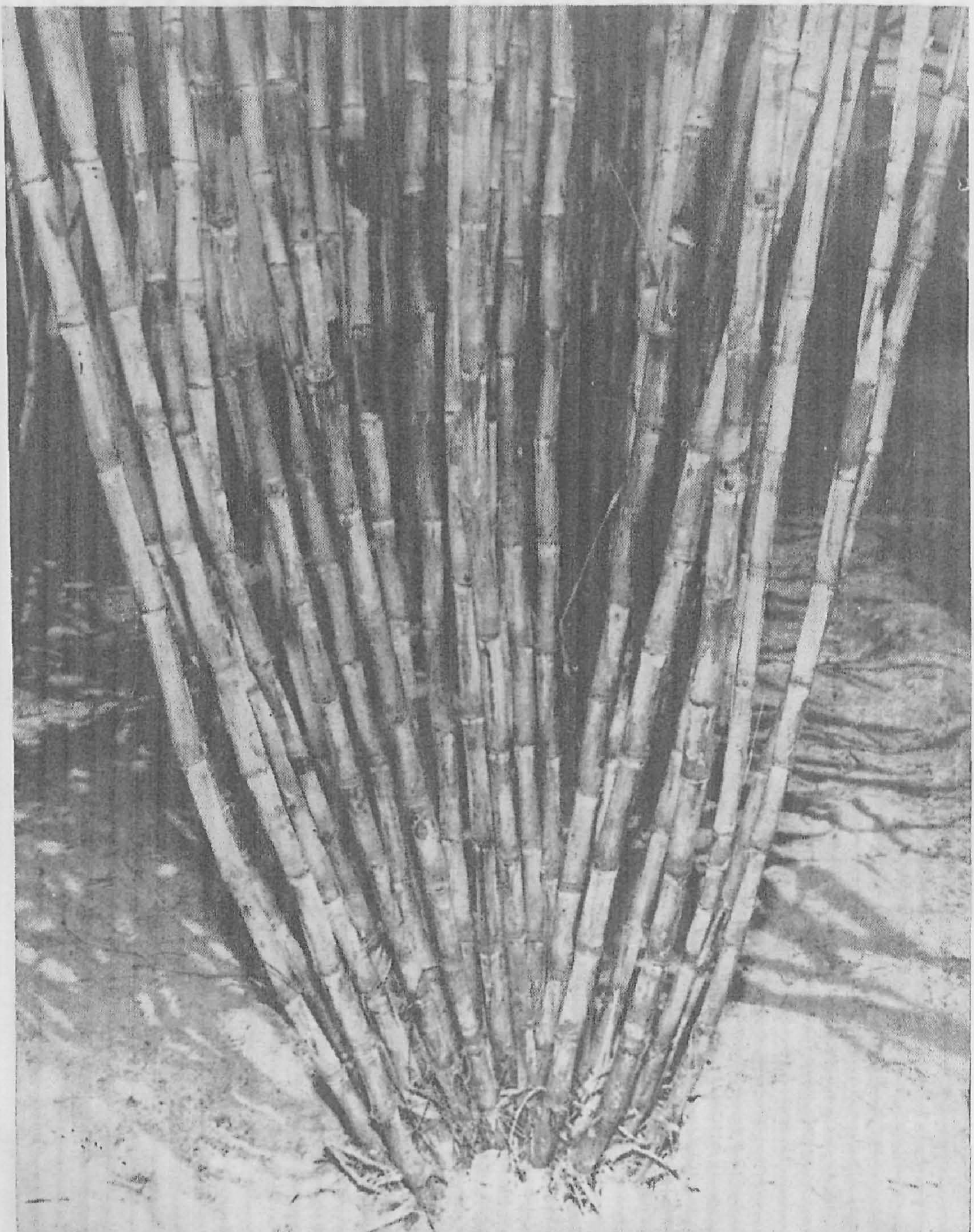


Fig. 13. Sugarcane tillers that have sprung from a one-budded sett at the IISR, Lucknow

CHAPTER 17

# RESEARCH INSTITUTES ON COTTON

## COTTON TECHNOLOGICAL RESEARCH LABORATORY, BOMBAY (1924)

THE Cotton Technological Research Laboratory (CTRL), formerly known as Technological Laboratory, was established by the Indian Central Cotton Committee (ICCC) in 1924 with the distinguished scientist, Dr A. J. Turner, as the first Director. Initially the Laboratory functioned from some rooms of the Victoria Jubilee Technical Institute at Matunga and the Haffkine Institute, Parel. The new building of the Laboratory was declared open on 3 December 1924 by Lord Reading, the Viceroy and Governor-General of India.

In the beginning the main work of the Laboratory was to assist the cotton breeders and other research workers in the evaluation of the quality of new strains evolved under various research schemes, and to carry out basic research investigations on fibre properties and spinning, and to study the interrelationships between fibre characters and yarn quality. The testing and research sections set up to fulfil those objectives were: Fibre testing, Spinning, Yarn testing, Physics, Chemistry, Microscopy and Statistics. As the usefulness of the work carried out at the Laboratory began to be realized by the cotton trade and industry, the scope of the work at the Laboratory was increased by the addition of new sections from time to time, e.g. the Testing House (1937), Ginning Section (1941), X-ray Section (1954) etc. The Laboratory came under the control of the ICAR from 1 April 1966 on the abolition of the ICCC and its name was changed to the Cotton Technological Research Laboratory.

### FUNCTIONS

The main functions of the CTRL are: to participate actively in the programmes for improvement in production and quality of cotton in India by evaluating the quality of new strains evolved by the agricultural scientists; to carry out research on the physical, structural and chemical properties of cotton in relation to quality and spinning performance; to carry out research investigations on the ginning problems of cotton; to investigate the greater and better utilization of cotton, cotton waste, linters, cotton seed, etc.; to help the trade and industry by providing reliable and accurate data on quality of representative trade varieties of

Indian cottons; to issue authoritative reports on the samples received for tests from other government departments, the trade and other sources, and to collect and disseminate technical information on cotton.

The CTRL has the following research Divisions/Sections : (*i*) Ginning, (*ii*) Quality Evaluation, (*iii*) Spinning, (*iv*) Physics, (*v*) Microscopy-Microbiology, (*vi*) Chemistry, (*vii*) Statistics, and (*viii*) Engineering.

The Laboratory also has nine regional units at the important cotton breeding centres in the country, viz. Coimbatore, Dharwar, Guntur, Hissar, Indore, Ludhiana, Nanded, Sriganganagar and Surat. Preliminary screening of experimental strains for fibre properties is carried out at these stations.

ACHIEVEMENTS

*Cotton improvement.* The Departments of Agriculture in the provinces initiated systematic work on cotton development. However, the constitution of the Indian Central Cotton Committee in 1921 and the establishment of the Technological Laboratory in 1924 were the primary factors in increasing the tempo of work in development of new cotton strains. Despite these efforts, significant improvement in cotton production could not be achieved before 1947, as some of the area under cotton cultivation had to be diverted for producing foodgrains. In 1947 the Indian textile industry faced an unprecedented shortage of cotton due to the partitioning of the subcontinent and transfer of almost the entire area where cotton was grown under irrigation to Pakistan. Hence foreign cotton had to be imported to the extent of over 1 million bales each year out of the total requirement of 3.5-4 million bales by the mills.

With the commencement of the First Five-Year Plan, a large number of schemes for evolving new varieties and developing better agronomic practices etc. were initiated and financed by the ICCC till its abolition in 1966. A much-needed impetus to these efforts was provided by the ICAR when it initiated the All-India Co-ordinated Cotton Improvement Project (AICCIP) in April 1967. The Laboratory is the centre for co-ordinating the technological work under the Project. Under the AICCIP the Laboratory is also endeavouring, in active collaboration with cotton breeders and other agricultural scientists, to produce sufficient quantities of quality cottons suitable for the textile industry.

Normally a large number of progenies are screened, keeping in view the economic characters like yield, ginning percentage and fibre characteristics. Over 10 000 samples are screened annually at the nine regional stations of the CTRL for fibre properties. At the main Laboratory over 3 000 samples are screened for both fibre properties and microspin-

ning performance. In addition, over 500 samples are subjected to full spinning tests. Before releasing a strain spinning tests are carried out at least for two to three seasons, at the laboratory and the textile mills. A careful watch is also kept on released varieties at different stages of multiplication, and by testing the trade varieties annually for fibre properties and spinning performance.

Development of superior-quality strains like 'Sujata' and 'Suvin' is an excellent example to show what a close collaborative effort of cotton technologist and breeder can achieve. This achievement was made possible due to strict adherence to prescribed norms for fibre properties and spinning performance at each stage of selection.

In addition to rigid quality evaluation, other aspects of research work at the CTRL, viz. ginning, standardization of fibre and spinning test methods, studies on structural features of cotton, relationship between fibre properties and structure factors influencing yarn quality, etc., have not only contributed to our knowledge of Indian cottons but also been responsible for the cotton improvement in India. A brief account is given below.

*Standardization of testing methods*. The Laboratory had undertaken detailed investigation on the study of interrelations among fibre properties and influence of fibre properties on spinning performance and yarn characteristics. These testing methods, standardized at the Laboratory, are employed widely in the country for testing fibre and yarn characteristics.

*Spinning and yarn characteristics*. A number of investigations have been carried out at the CTRL to study the influence of fibre properties on yarn quality and spinning performance. Special mention has to be made of the work on foundation of yarn strength and yarn extension; this work carried out during the formative years of this Laboratory still receives a great deal of attention all over the world. The Laboratory also introduced the highest standard count as an index of spinning potential of cotton for evaluating varieties. A full-scale spinning procedure for assessing the spinning performance of a small quantity of sample weighing 5 kg and a micro-spinning technique for assessing breeders' samples weighing as low as 80-100 g using conventional machinery were evolved.

Recent investigations on the suitability of various strains for blending with natural and man-made fibres have demonstrated that varieties like 'MCU 5', 'Hybrid 4', 'Varalaxmi' and 'Sujata' are well suited for blending with polyester for different count ranges. Blended yarns

with cotton and jute caddies (up to 20% caddies) have also been produced successfully on cotton-spinning system and fabrics, which could be used for upholstery and furnishings.

*Ginning*. Pre-cleaning and ginning tests are conducted on each new variety of cotton soon after its release. The notable contribution of the Laboratory in this field has been the development of the Laboratory Model Gin and Ginning Percentage Balance. These have been found very useful by cotton research stations and marketing centres. Some of these units have also been exported. Another item of development is the fabrication of a *kapas* extractor capable of removing immature locks, hulls, etc. from seed cotton.

*Structural and chemical studies*. It is well recognized that strength and other mechanical properties of cotton fibres depend on its structure. The loss in strength or wear-life of easy-care finished fabrics is to a large extent due to the inherent heterogeneous structure of the cotton fibre and non-uniformity of the distribution of cross-links. Basic research in the field of structure and properties *vis-a-vis* chemical modification of cotton fibres is therefore very important. The Laboratory has amassed exhaustive data on structural peculiarities of Indian cottons using light/polarized light microscope, electron microscope, X-ray and electron diffraction techniques and IR spectrophotometer. In recent years many new techniques have been developed to elucidate fine structure of cotton fibre both before and after swelling or chemical modification.

*Utilization of cotton plant by-products*. Detailed analysis has been carried out on the linter, oil, protein and gossypol contents of seeds of different varieties of cotton. A project is in progress on preparation of particle boards from cotton-plant stalks. A project has also been taken up recently on grading of linters.

*Utilization of by-products of cotton and agricultural waste materials*. A process has been patented recently for the production of cellulose enzyme by growing a strain of *Penicillium funiculosum* ($F_4$) on agricultural cellulosic waste materials like linters, bagasse, wheat-straw pulp, cotton- and jute-stalk pulp etc. as carbon sources. This enzyme has practical application in effectively desizing tamarind kernel powder (TKP) or modified TKP in the textile industry and in the saccharification of cellulosic agricultural waste.

*New instruments*. Besides the Laboratory Model Gin, Ginning Percentage Balance and *kapas* Extractor already mentioned, the Laboratory has also developed and fabricated other instruments useful for

testing cottons. These include : (*i*) the A. N. Stapling Apparatus, capable of giving fibre length and linear density details,(*ii*) Halo Length Disc, for easy estimation of fibre length even in the field, (*iii*) Interferometric Fibre Stapler, for determining fibre length characteristics, (*iv*) Lint Opener for preparation of lint sample for Micronaire tests, and (*v*) Microtome, for preparing cross-sections of textile fibres for microscopic observations.

EDUCATION

The Laboratory is recognized by the University of Bombay as a postgraduate institution to train students for research in Textile Physics (M. Sc. and Ph. D.), Biophysics (Ph. D.) Textile Technology (M. Text.) and Physical Chemistry (M.Sc.) . The Laboratory also gives training in the methods of textile testing to the candidates sponsored by the cotton trade and the textile industry. Training is also given to gin fitters sponsored by the ginning factories.

CENTRAL INSTITUTE FOR COTTON RESEARCH, NAGPUR (1976)

The Central Institute for Cotton Research was established in April 1976 at Nagpur. The station at Coimbatore in Tamil Nadu established by the ICAR in 1960 under the Project for the Intensification of Research on Cotton, Oilseeds and Millets in the region was attached to this Institute to function as its Regional Station for the southern region.

This Institute has been established to carry out fundamental and basic path-breaking research to meet the long-term objectives of having increased production of cotton in quantity and quality, so that the country is self-sufficient in cotton production. A number of basic studies involving long-term objectives have been envisaged for stepping up the cotton production in India.

One of the most important tasks is assembling, cataloguing, evaluating and utilizing the diverse genetic resources to produce diversifying advanced breeding material, and also varieties with in-built resistance to pests and diseases and giving higher yields of lint with suitable quality. This Institute will thus serve as a germplasm bank and will keep the free flow of genetic advanced breeding material to the scientists for selection, and breeding location-specific varieties. The Institute has collected nearly 4 000 genetic lines.

Apart from cultivated species, there are more than 28 allied wild species of cotton. Many of them have desirable characters like resistance to insect pests and diseases and latent fibre characteristics which could be transferred to the cultivated varieties. It is necessary to ex-

ploit the wild germplasm for improving cultivated cottons, and needed inter-specific hybridization programmes will have to be carried out under a permanent set-up.

With the development and release of a large number of improved varieties, the indigenous stocks as well as obsolete varieties are going out of cultivation and in many cases they have become extinct. It is now realized that many of the indigenous stocks are useful sources of resistance to insect pests like jassids (e.g. variety 'Co 2' released in 1928) It is therefore imperative that the genetic wealth in cotton should be preserved by organizing the collection programme, and to evaluate and maintain the same on a permanent basis in this Institute. The breeders in the country will then be able to draw freely from this source, for their applied improvement programmes.

The programme of breeding for resistance to insect pests like jassids and bollworms and diseases like *Verticillium* wilt and bacterial blight requires to be supported through basic studies involving genetic and biochemical basis of resistance of the host plant, including cultivated and allied wild species. This knowledge will be utilized in the applied breeding programme to be carried out under the co-ordinated project. The main features of the work to be done under the project are as follows :

Development of long-staple, short-duration and high-yield breeding material and varieties genetically resistant to pests and diseases for rainfed conditions, which constitutes the main area of cotton in India. Varieties and breeding material with desired yield and quality characters fitting in the multiple cropping system in irrigated areas are also to be developed.

Exploitation of hybrid vigour, utilizing male-sterility and thereby developing suitable hybrids combining high yield and good fibre quality for the rainfed and irrigated areas.

To study the basic aspects of drought resistance, responsiveness and non-responsiveness to fertilization, study of rooting system involving radiotracer techniques. In many cases there is immobilization of the nutrients before reaching reproductive parts, the reasons have to be identified through appropriate fundamental studies.

Physiological basis is to be worked out to develop and provide proper basis for the selection criteria in evolving varieties and hybrids and designing experiments in the field of agronomy and soil science.

Development and evaluation of components of integrated system at national level for controlling major and minor insect pests, that can

be incorporated into the location-specific control system. Intensive studies on the interaction between the incidence of pests, weather and efficacy of various pesticides are to be made in different situations so as to increase the efficacy of the pesticides used for production of cotton crop.

The processing techniques in cotton industry are undergoing vast transformation. New processes like open-end spinning, warp knitting and chemical finishing to yarn and fabric are being introduced by the industry. It is necessary for the varietal improvement programmes in cotton to keep pace with these changes in the technology. For this purpose it is necessary to determine the parameters for fibre quality and relate them to new technological changes. Therefore basic research is to be made to develop varieties and breeding material with suitable strength and elongation characters for chemical finishing. Such varieties should also withstand the chemical processing better for obtaining easy-care characteristics.

In a commercial crop like cotton, changes are taking place in market preferences based on technological advances and competition from man-made fibres. It is therefore necessary to carry continuously agro-economic research on cotton consumption, market survyes and production costs, so that the research programmes on cotton are kept uptodate, based on changing needs of the industry. Such work will have to be carried out under permanent set-up of the Institute.

Research to develop appropriate seed-production technology has been initiated so that good-quality seed, a basic input in cotton production can be produced under various situations.

Educational training for personnel from different regions is also being taken up, so that technology developed out of the researches can be taken up at the farm level and gap between research and the field is minimized.

In the establishment of this Institute, the Government of Maharashtra and Punjabrao Krishi Vidyapeeth, Akola, have been generous in extending all possible help. The Maharashtra Government and its State Department of Agriculture has transferred a farm of 42 ha for establishing the main research farm. Punjabrao Krishi Vidyapeeth, Akola, has allotted 10.12 ha land for the residential complex and another 20.23 ha for research on irrigated cotton.

The cultivated land on both the farms has been developed and laid out for field research. The land suitable for cultivation, but still under forest, is being cleared. At present the Institute is functioning in two

separate buildings, one of them is rented and the other has been given by the Punjabrao Krishi Vidyapeeth, Akola, in which the Institute started functioning when it was established.

The Regional Station, Coimbatore, was established in 1960 and has done outstanding research. This station has evolved high-quality varieties like 'Sujata' and 'Suvin' with good adaptabilities to the climatic conditions. These varieties have been adjudged equivalent to the Egyptian cotton like 'Giza 45'. The cultivation of these varieties has eliminated the import of quality cottons from foreign countries.

The first short-branched type and early-maturing cotton 'PRS 72', suitable for intensive cropping system, was developed by this station and has been released for general cultivation. By using 'Gragg' male-sterile line, short-duration and medium-staple hybrid 'CPH 2' was evolved. The cost of seed production by using male-sterile line is considerably reduced. Short-duration varieties like 'CP 15/2' ('Suman') and '1412', both having high-yield potentials and suitable for irrigated and rainfed areas, have been developed and released for general cultivation. 'MCU 5-WT', a variety resistant to *Verticillium* wilt, has been developed at this station

Research to improve the quality of the interspecific hybrids and to develop suitable production technology is in progress. Basic studies on photosynthetic efficiency, utilization of nutrients and other inputs are in progress Significant achievements have been made in the studies made on integrated pest management in the operational research project. This has helped in reducing the cost of pesticides without affecting the yield and quality of cotton.

The CICR is also imparting training in cotton production to the scientists and officers deputed form Burma, Ceylon and other neighbouring countries. Imparting training to the scientists and development officers is a regular feature of the Institute.

DIRECTORS

The Institute has been headed by the following scientists as Directors from time to time since its establishment in April 1976: Dr V. Sundaram (1 January 1976 to 18 January 1977), Dr K. V. Srinivasan (19 January 1977 to 31 December 1977), Dr V. Sundaram (1 January 1978 to 6 February 1978) and Dr Chokhey Singh (7 February 1978 onwards).

CHAPTER 18

# RESEARCH INSTITUTES ON JUTE AND LAC

## JUTE AGRICULTURAL RESEARCH INSTITUTE, BARRACKPORE (1953)

THE Jute Agricultural Research Laboratory was established in 1939 at Dacca. Dr J. S. Patel joined as the Jute Specialist (later Director) of the JARL. The base for systematic research work was laid out by him after reviewing the work done in the past by the Department of Agriculture, West Bengal, and the Imperial Council of Agricultural Research. The pioneering jute scientists who assisted Dr Patel were: Mr R.L.M. Ghose (Breeding), Mr A. T. Sanyal (Breeding), Mr S. S Ghosh (Anatomy), Dr G. M. Das (Entomology), Mr V. S. Varadarajan (Mycology), Mr B. Dasgupta (Breeding) and Dr A. Bose (Chemistry).

Before the setting up of the Laboratory, work on various aspects of jute was looked after by the Indian Central Jute Committee, which was set up on the recommendation of the Royal Commission on Agriculture in 1936. Sir Bryce Burt, the Vice-Chairman of the Imperial Council of Agricultural Research was the first President of the ICJC (1936-38).

The first meeting of the agricultural subcommittee was held on 10 February 1937 under the Chairmanship of Dr W. Burnes. This meeting suggested research studies on the various aspects of jute. Another recommendation was to conduct multi-location trials, which could be called the beginning of the co-ordinated approach in agricultural research in India. The Agricultural Subcommittee on Jute in its formative period had on its advisory panel eminent scientists, viz. Prof. Satyen Bose, Dr M. N. Saha, Prof. S. P. Agharkar, Prof. P. Maheshwari, Prof. J. C. Sengupta and Dr P. N. Sen.

A significant agronomic finding was that row cropping resulted in higher yields compared with the traditional practice of broadcast sowing. The seed-borne nature of jute-rot disease caused by *Macrophomina phaseoli* was established. The pests of jute were described with details of their life-histories.

Mr Varadarajan left in 1943 and Dr T. Ghosh joined as the mycologist. He found that stem rot of jute could be controlled by adding potash to soil and by correcting the soil pH. The relation between seed moisture and seed viability was established and the critical limits were spelt out. The seed-storing methods of maximum viability were suggested. He found that chlorosis or leaf mosaic in jute was due to a

virus, whose vector is active only in Assam.

The year 1946-47 was crucial to the ICJC and jute research. Sir Datar Singh took over as President of ICJC and Dr B. C. Kundu, a distinguished Professor of Botany, joined as the Director of the JARI. Soon following the partition of India, Dr Kundu and his team brought valuable strains from Dacca, and reached Chinsurah in West Bengal, where they continued the work during the period 1948 to 1953. Administrative sanction was received to set up the new Institute (JARI) at Barrackpore. Mr Rafi Ahmed Kidwai laid the foundation stone of the new laboratory building in 1953. The transfer of 41.38 ha of land at Nilganj, Barrackpore, was effected, due to the generosity of Dr Bidhan Chandra Roy, Chief Minister of West Bengal.

Dr B. C. Kundu and Mr N. S. Rao worked out the anatomy of the origin of fibre in jute, and also the features related to quality and yield. One advanced-generation culture found promising in Dacca was tested in Indian conditions, and released as 'JRO 632'. It became popular all over the *C. olitorius* belt, and in course of time completely replaced the 'Chinsurah Green', the first *C. olitorius* variety of West Bengal which had resulted from the research of Dr R. S. Finlow and co-workers Other important jute varieties selected in Dacca, and further evaluated and released during this period were : 'JRC 212', which outyielded the 'D 154', this was found suitable for high and medium lands; 'JRC 412', an early-maturing, quick-growing strain selected from a local strain, which was later found to be highly susceptible to stem rot; 'JRC 321', a selection from local type 'Hewti', which is an early type suitable for lowland conditions.

'JRC 212' and 'JRC 321' are still the popular varieties in the *C. capsularis* belt. The mesta varieties evolved during this period were 'HC 58C' and 'HS 4288' (P. Sanyal, A. N. Datta, S. C. Rakshit, K. Chakravarty). An inter-specific hybrid between *Hibiscus radiatus* and *H. cannabinus* was achieved by Dr P. Sanyal.

Dr Kundu's special task was to organize jute development by extending the area in post-partition India. This was a task of great national significance, since jute remained the mainstay of Indian economy, and owing to partition the country had lost its jute belt. Extensive surveys were made and more and more efficient areas were identified in West Bengal, and the area under jute increased three-folds from that of 1947. This saved the jute industry of India.

During this period Dr M. K. Mukherjee joined as the Head of the Section of Agricultural Chemistry and Microbiology (1950-63). The

important findings that he and his team made were: improvement of soil fertility by the feed-back of the massive leaf fall; the soil-available P status and the soil fertility as affected by jute cropping (A. K. Mandal); the microbial flora responsible for jute retting (A. K. Kundu); substances re moved during retting (A. K. Kundu, A. B. Roy); and the manurial value of retting water.

Fundamental physiological studies were made by Dr B. K. Kar and Mr J. R. Saha. The flowering responses of jute and mesta to the photoperiods were understood.

Following Dr G. M. Das, who left the Entomology section, Dr N. Datta joined. He identified and described *Nupserha bicolor postbrunnea* Dutt, a new pest of jute, with the minutest details of the host-pest relationship. He also identified the parasites of *Apion corchori* and the semilooper.

Research at the JARI at this stage was mainly confined to jute; mesta was added to it since this crop was increasingly used in the millsas a substitute. Dr M. S. Randhawa was President of ICJC from 1955 to 1960. He constituted a committee consisting of Dr B. P. Pal, Prof. R. S. Dastur, Dr B. N. Lall, Dr S. K. Pradhan and Dr. B. S. Kadam to review the researches done in jute so far.

Some of the far-reaching administrative decisions of the ICJC taken during this period are : a Sisal Subcommittee (1958-59) was constituted and was headed by Dr S. M. Sikka with the objective of developing sisal in India; the Government sanctioned Rs 169 000 to set up the Ramie Research Station at Assam; 19 ha land was purchased; the Agricultural Subcommittee (1959-60) decided to formulate a seed scheme to ensure supply of improved seeds; then 65.66 ha land was acquired at Panagarh, Bud Bud; a subcommittee was set up under the Chairmanship of Dr V. G. Panse to study the economics of jute growing.

Dr M. S. Randhawa realized the necessity of documenting and publishing all that was known about jute. As a result, Dr B.C. Kundu, Dr P. B. Sarkar and K. C. Basak brought out an excellent monograph on jute. Dr Kundu also established a library in the JARI.

It was later observed that the scope of expansion of area under jute was limited. Dr M. S. Randhawa in his new capacity as Adviser (Resources) of the Planning Commission asked for a study on the identification of efficient areas of optimal production. An informative bulletin was published by the Natural Resources Division of the Planning Commission under the title: *Studies on Jute and Mesta in India* (1963).

In November 1960 Mr V. Shanker took over as President of the

ICJC. The schemes on ramie, sisal and seed multiplication were executed during this period. The scope of the JARI was broadened to accommodate research work on mesta, ramie, sisal and also sunnhemp.

Dr K. T. Jacob succeeded Dr Kundu as the Director (1962-64). He had distinguished himself in the field of mutation breeding of jute at the Bose Institute, Calcutta, before joining this Institute. Dr Jacob and Dr Subir Sen reported the first ever monoploid of jute, indicating its utility in genetic research. Dr T. Ghosh took over as Director in 1964. In 1966 the JARI was taken over by the ICAR.

Emphasis was given to the concepts generated in jute research over the past quarter century and the continuity was maintained. The emphasis given to Mr B. Dasgupta's identification of the premature-flowering resistance of 'Sudan Green' and its non-shattering pod inspired the later workers to take advantage of this trait, long after Mr Dasgupta left this Institute. By incorporating the 'Sudan Green' gene, new premature-flowering-resistant varieites were evolved by Mr B. Roy, and Mr K. Chakravarty. 'JRO 7835' or 'Basudev', named after late B. Roy, is a derivative of the cross between 'JRO 632' and 'Sudan Green'. The families were selected for high fibre : wood ratio and this paid rich dividends. 'JRO 878' came from 'JRO 620'×'Sudan Green' cross. Besides, premature-flowering resistance, the good fibre quality and red marker gene of 'JRO 620' are also inherited by 'JRO 878'. 'JRO 524', the latest in the above series, is also a line derived from 'Sudan Green'× 'JRO 632' cross. This variety is acclaimed to have the best quality of fibre and the most facile retting.

The mutation breeding for most part has thrown light on the fundamental qualitative genetic traits of jute. It also resulted in a good *colitorius* variety, 'JRO 3690', derived from a cross between two low-yielding mutants.

## JUTE TECHNOLOGICAL RESEARCH LABORATORIES, CALCUTTA (1938)

The Jute Technological Research Laboratory was established in 1938 at Calcutta by the Indian Central Jute Committee to carry out research on technological aspects of jute. The building of the Institue was opened on 3 January 1939. It has full facilities for spinning jute for quality evaluation. Further expansion of the laboratory took place in 1959 when the east block of the Laboratory was built.

After a fruitful existence of 28 years, the Indian Central Jute Committee was abolished and the Laboratory came under the direct manage-

ment of the ICAR with effect from 1 October 1965.

The main objectives of the Laboratory are: to carry out technological research on jute and other long vegetable fibres for the benefit of growers and industrialists; to meet the needs of the agriculturists for the production of good-quality fibre; to upgrade product quality by improved processing methods; and to evolve new methods of utilization of fibres, agricultural by-products and industrial wastes.

The Laboratory now comprises five research divisions: Textile Technology including Workshop, Chemical Technology including Pulp and Paper Technology, Chemistry, Microbiology and Physics including Raw Jute Grading. In addition, there are two sections on Non-Woven Technology and Testing.

It has a well-stocked library and a composite Museum on jute and other vegetable fibres. The personnel of the Museum and the research workers also undertake extension services. A significant feature is the Mobile Jute Exhibition (Museo-Bus). The technological unit of the All-India Co-ordinated Research Project on Jute and Allied Fibres is also located here.

CONTRIBUTIONS OF DIRECTORS

The Laboratory started functioning at Calcutta under Mr C. R. Nodder as its first Director. During his tenure, the Laboratory at the early stages concentrated more on the collection of basic data about the fibres than on achieving results for immediate application in the industry.

After his retirement, Dr P. B. Sarkar took charge on 18 July 1949. His contributions towards the chemistry of bast fibres and plant by-products for their utilization are well recognized. The expansion of research activities and of facilities in the form of equipments and building which took place under his directorship remain as assets of the Laboratory. Dr Sarkar retired on 31 May 1967.

Dr S. B. Bandyopadhyay was Director of the Laboratory from the 15 January 1968 to 31 December 1975. He made significant contribution towards the understanding of frictional properties of fibres and the length of distribution of filaments in the slivers and yarns. His efforts to bring about a more fruitful relationship between laboratory results and their industrial application remain an example to follow.

The present Director of the Laboratory is Dr A. C. Chakravarty, who took charge on 1 October 1975.

ACHIEVEMENTS

Since its inception the Laboratory made significant contributions towards agricultural and technological research on jute and other fibres. Some of these are described below.

*Jute quality.* On quality aspect of fibre the Laboratory did pioneering work in the field of fibre-quality assessment. Mention may be made of the technique of measuring the spinning quality of fibre from small-scale trial on standard jute-processing machinery and designing of instruments for the measurement of fibre quality such as strength, fineness, colour and lustre, and bulk density. Quality-evaluation techniques had been of much help in evolving new strains of jute, as well as the norms of agronomical practices based on the findings, such as (*i*) thin plants produce good-quality fibre, (*ii*) high dose of nitrogenous fertilizer lowers fibre quality, and (*iii*) early harvest does not impair fibre quality.

A 5-yearly survey (1968-72) on the quality of commercial fibres from different jute-growing States revealed that areas like Orissa, Tripura, Assam and West Bengal produce good-quality fibre.

*Fibre extraction.* A standard method for the extraction of fibre from jute ribbons by chemical method has been worked out by the Laboratory. This will help the fibre-quality assessment in the agronomical and breeding trials on jute.

To tackle the problem of jute retting, the Laboratory has developed a prototype ribboning machine, which will help improve the fibre quality and remove the inconvenience due to shortage of water required for proper retting. The device may be used in retting the plant ribbons after separation from stick.

*Jute grading.* Extensive work carried out in the Laboratory on physical properties of fibre and yarn of different varieties provided suitable methods for testing, fibre grading and estimating the spinning values from fibre characters. This formed the basis of Laboratory's contribution towards the formulation of revised grading specifications of raw jute (IS: 271-1975) of the Indian Standards Institution, which has been officially adopted for jute marketing in our country. The Laboratory is also a centre for the preparation and supply of grading aid album of fibre specimens corresponding to different gradations of each of the important fibre-quality characters. These sample books have been very helpful to persons engaged in the job of jute grading.

*Chemical and physical nature of fibre.* Basic studies on the chemical constitution of a number of bast and leaf fibres as well as other agricul-

tural raw materials have contributed towards the knowledge of its chemistry. These have been the basis of chemical treatment for product quality improvement.

Research on the fine structure and physical properties of a number of bast and leaf fibres revealed the nature of the fibres for improving upon the method of processing. Studies on the structure-property relationship of jute yarn have introduced new ideas in the field.

*Fibre upgrading*. Chemical treatments have been evolved for removing dark shades of grey jute, and brightening dark hessian. The brightened hessian has a good foreign market.

For upgrading of barky root cuttings which cause heavy loss to the jute mills, the Laboratory introduced the ammonium phosphate process. A pure strain of fungus with specific action on barky jute fibre has been recently isolated by the Laboratory. Laboratory experiments and industrial trials at a number of jute mills showed that this method can be utilized for spinning hard barky portion into fairly good-quality yarn, which can be utilized for hessian warp.

PRODUCT DIVERSIFICATION

Some of the significant contributions are : (*i*) fine yarn from jute fibre after some special treatment, (*ii*) hydrogen peroxide bleaching process involving lesser loss in weight and strength, (*iii*) resin treatment of fabric for dimensional stability, (*iv*) non-yellowing bleached jute by an economic method, (*v*) suitable dyeing process for jute fabric to be used for wall covering, drapery and furnishing materials, (*vi*) improvement of woolpack and cement bag, (*vii*) woollenized jute to produce knitting yarn, cheap blankets, wrappers in admixture with wool, (*viii*) cotton, wool and polyester to prepare blended textile material incorporating jute, which may have appeal as novelty products.

Jute stick is a by-product of jute cultivation. Its economic utilization would not only increase the growers' income and help stabilize the raw jute price, but also meet the ever-growing demand for a fresh source of cellulosic raw material for paper, board and allied industries. Various jute-stick products developed at the laboratory are : (*i*) paper—writing, printing, kraft, newsprint, speciality product etc., (*ii*) box board by lime digestion, (*iii*) rayon-grade pulp tyre-cord type by a suitable pulping process, (*iv*) material suitable for lacquer from jute stick pulp nitrocellulose, (*v*) a flexible roofing material treated with asphalt, (*vi*) hard board and particle board.

Methods of extraction of good-quality wax, pectin and hecogenin

from waste sisal pulp have also been developed.

When availability of jute is scarce, processing of substitute fibres, mesta and roselle was recommended. They are regularly used in jute mills now. Methods of processing *Urena lobata*, linseed flax and low-grade sunnhemp on jute machinery were also developed.

Later a technique has been devised for processing banana-plant fibres as substitute of jute, and pineapple-leaf fibres as a blending material on jute machinery to be used for diversified products. These may be considered successful methods towards agricultural waste utilization.

A process developed at the laboratory can spin raw ramie for sewing threads, furnishing fabrics, etc. The Laboratory's degumming process and technique for spinning degummed ramie had led to the development of jute ramie, viscose-ramie, polyester-ramie and wool-ramie blends suitable for apparel and sophisticated furnishing fabrics.

## INDIAN LAC RESEARCH INSTITUTE, NAMKUM, RANCHI (1925)

The Indian Lac Research Institute came into existence in 1925 as a result of the recommendations of a two-man enquiry committee, comprising Messrs H. A. F. Lindsay and C. M. Harlow, appointed early in 1920 by the Government of India to enquire into the conditions of the Indian lac trade and to suggest measures for its all-round improvement. They reported (in 1921) two major ills from which the lac trade was then suffering, viz. liability to violent price fluctuations and adulteration in times of short supply, which could be cured only by increased out-turn , for which recourse should be had to intensive cultivation by scientifically tested methods rather than to extensive cultivation. It was to implement this suggestion that the Indian Lac Association for Research, a private registered body of merchants, set up the Indian Lac Research Institute in 1925.

The Association, however, did not remain long in charge of the Institute, its control and direction having been passed on to the Indian Lac Cess Committee, a statutory body formed under the revised Lac Cess Act of 1931. The Committee maintained the Institute till 31 March 1966. With the abolition of the Committee the Institute was taken over by the ICAR with effect from 1 April 1966.

### OBJECTIVE

The main objective of the Institute is to carry on research towards effecting improvements in the cultivation, processing, standardization

Fig. 14. Tractor-drawn implement for planting sugarcane

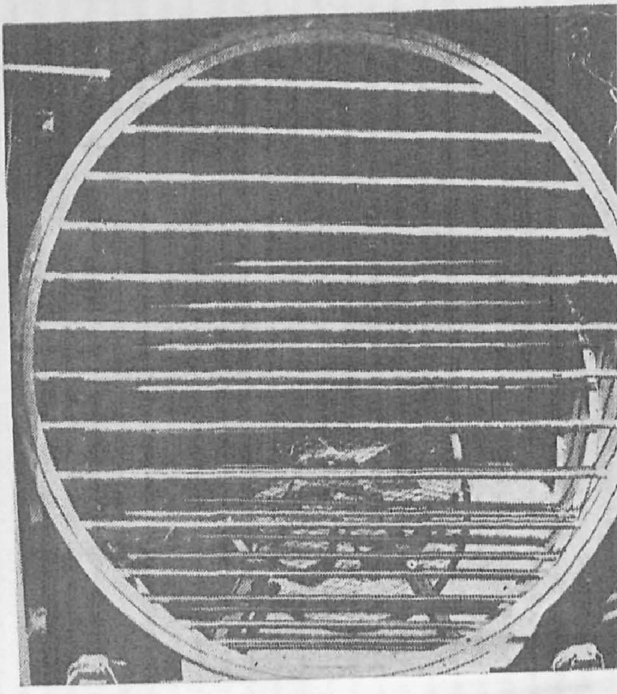
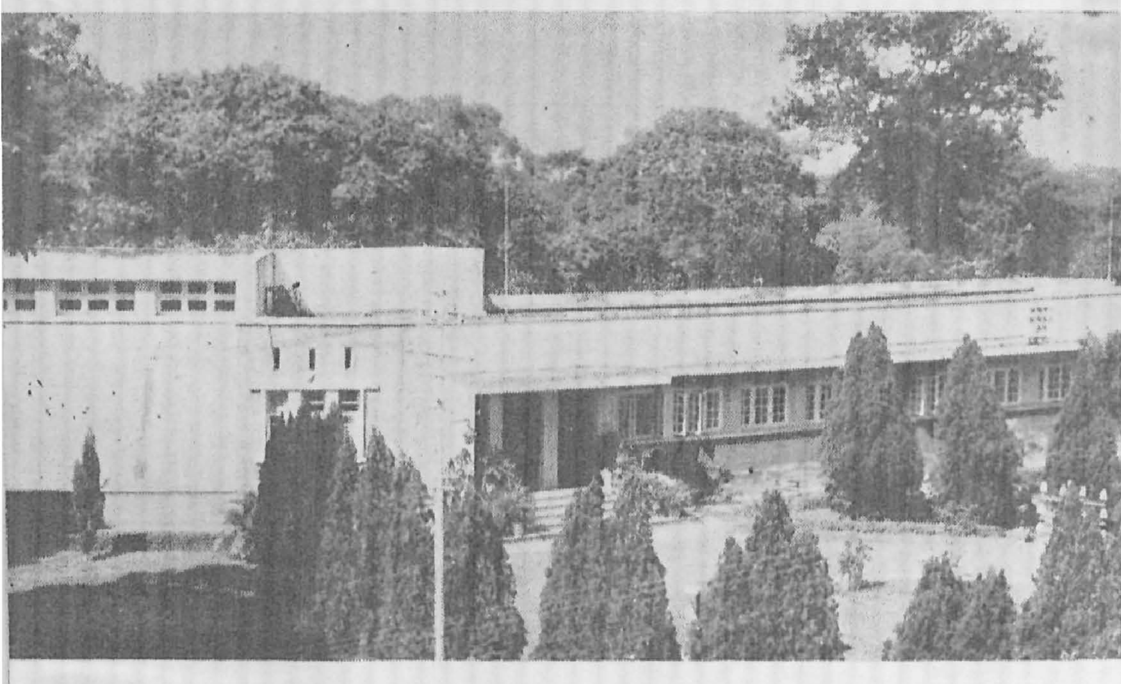


Fig. 15. Hot chamber for treating sugarcane setts at the IISR, Lucknow

Fig. 16. Jute Agricultural Research Institute Barrackpore—laboratory building

Fig. 17. Indian Lac Research Institute, Namkum, Ranchi—administrative block



and modifications of lac through scientific research to intensify its cultivation and extend its utilization. In addition, the Institute is also to carry on publicity and maintain liaison with and provide technical service to the indigenous industries towards improving the quality of their products and increased utilization of lac.

## Growth and Organization

The Institute originally consisted of the Entomological Division as the Chief Unit, supported by a Biochemical Section to help in certain aspects of entomological research. To this was added the Physico-chemical Section some time after 1927 to carry out applied research. Subsequently, however, the Biochemical and Physico-chemical Sections were replaced by a Chemical Division. The establishment of this division, functioning as a distinct essential unit, thus marked a great departure from the original programme aimed at the evolution of improved methods of cultivation only.

The Institute passed through four more or less distinct phases of research activities.

The first phase started with an entomological programme with dovetailing of certain ancillary biochemical problems, and ended with the addition to it of certain applied problems.

The second phase, which coincided with the Second World War period, witnessed a considerable increase in the volume and variety of work, particularly in the chemical and chemo-technical side, to cope with some urgent war problems. The Institute underwent a corresponding increase in staff and laboratory facilities during this phase.

The third phase, commencing with the cessation of the Second World War, was marked by an appraisal of the earlier work by the First and the Second Reviewing Committees appointed by the Government of India in 1951 and 1956. These Committees drew out expanded research programmes with equal emphasis on the fundamental and applied side, and recommended securing of collaboration of other research institutions for undertaking some items of fundamental research. This period also witnessed setting up of Regional Field Research Stations for intensified research on lac cultivation. The first two stations were opened at Jhalda (West Bengal) and Damoh (Madhya Pradesh) in 1957, the third at Mirzapur (Uttar Pradesh) in 1960, and the fourth at Umaria (Madhya Pradesh) in 1961. While the first three stations were closed upon the completion of studies, the station at Umaria was transferred, due to certain practical difficulties, to Dharamjaigarh, District Raigarh,

Madhya Pradesh, in 1967 and is still operating. Simultaneously, in pursuance of a recommendation of Bihar Shellac Conference, a decision was taken in 1955-56 to set up Regional Testing Laboratories at some of the manufacturing centres for testing of seedlac and shellac for helping the manufacturers to produce and maintain standard qualities. These laboratories were set up at Gondia and Jhalda in 1959, at Balrampur and Daltonganj in 1961 and at Namkum in 1962. At present, however, only the laboratory at Namkum is functioning.

The fourth phase commenced with the taking over of the Institute by the ICAR in 1966. During this period the Institute has been further strengthened and reorganized into the following five Divisions, as proposed by the Third Reviewing Committee, viz. Entomology, Agronomy and Plant Genetics, Chemistry, Technology and Extension.

RESEARCH COLLABORATION

Apart from the ILRI which has undoubtedly been the chief research unit, the Indian Lac Cess Committee also organized and maintained two research establishments overseas in the principal shellac-consuming countries. These were (*i*) the London Shellac Research Bureau in the United Kingdom which functioned from 1933 to 1947, and (*ii*) Shellac Research Bureau of the Polytechnic Institute of Brooklyn in the USA in co-operation with the United States Shellac Importers Association in New York from 1934 to 1939. Although these institutions existed only for limited periods, they did a considerable amount of fundamental and applied work. Several applications of lac for defence and other purposes during the Second World War are directly traceable to the results of research by these institutions.

Lately the Institute has sought to take advantage of technical know-how and facilities available in other institutions within the country. Accordingly, a research project was implemented from 1960-1971 under which the constitution of lac was studied simultaneously at the Chemistry Laboratory of the Delhi University under the guidance of Professor T. R. Seshadri and the National Chemical Laboratory, Pune, under the guidance of Dr Sukh Dev. In addition, under a separate scheme, study was taken up on the development of shellac-based leather finishes at the Central Leather Research Institute, Madras, from 1963 to 1971. Another scheme on the constitution of lac dye was operated at the National Chemical Laboratory, Pune, from 1960 to 1971.

Facilities have also been sought for and obtained from the Indian Institute of Technology, Kharagpur, for work on shellac-rubber com-

binations, from the Jute Agricultural Research Institute, Barrackpore, for irradiation of seeds and lac insects for mutation studies and from Agricultural Research Institute, Kanke, Ranchi, and a few other institutions for agronomical studies.

The Institute has also taken advantage of International Technical Co-operation Scheme to provide specialized knowledge to its employees.

EXTENSION, ADVISORY AND TRAINING SERVICES

In addition to carrying out research the Institute also takes part in publicity work to a limited extent. Till November 1951 it was engaged in a demonstration campaign in collaboration with several State Governments for popularizing the improved methods of lac cultivation. Subsequently, because of the increasing volume and importance, this work was put under a separate section headed by a Special Officer for Lac Cultivation, and ultimately a separate Directorate of Lac Development under the Ministry of Food and Agriculture, Government of India, was created in 1966 to undertake all activities relating to extension of lac cultivation.

The Institute was also maintaining a Utilization Section, later converted into a separate Extension Division during the Fourth Plan period, which has been providing technical service to manufacturers and consumers of lac to help increase internal consumption. This Division is also operating a Pilot Production Unit to popularize the new products developed at the Institute, and it maintains the testing laboratory where samples of lac and lac products received from the industry are tested. The scope of this Division is being enlarged to include all extension work relating to lac cultivation and utilization to be undertaken by the Institute.

Other major activities of the Institute have been the assistance rendered to the Forest Department of the Government of Bihar in large-scale cultivation of lac on *palas* at Kundri and forecasting of the dates of larval emergence during different seasons.

An Operational Research Project to try and demonstrate the package of practices for improvement of lac production in Chotanagpur area (Bihar) has also been started in a group of four villages in Ranchi district since April 1975.

The Institute provides two courses of training of 6-month duration on improved methods of lac cultivation, and of 3-month duration on industrial uses of lac. Training is usually given to deputees of Central and State Governments and industrial undertakings. In addition,

short-term training on specific lines is also provided on request.

CONTRIBUTIONS OF DIRECTORS

Mrs D. Norris (1923-36) was the first Director and Biochemist of the Institute. She took active interest in establishing the Institute, which began its research activities from August 1925. An important event of her period was the starting of the Biochemical and Entomological Laboratories in 1925. An area of about 35 ha, adjacent to the Institute campus, was taken up for raising plantation of lac-host plants. An experimental lac factory was started in May 1939. A co-operative research system between India, the UK and the USA was established in 1933. A Training and Demonstration Programme in lac cultivation was started to educate cultivators in improved techniques.

Dr H. K. Sen (1936-44), an eminent chemist, took over charge as the Director of the Institute from May 1936. Apart from research activites the other important events of his period included a demonstration of the processing technique arranged before 80 manufacturers of lac and a joint lac conference representing all interests of the lac industry held under the Presidentship of Dr Syed Mahmood, Minister of Education and Development, Bihar, in 1938. A High Tension Laboratory for research work on the electrical properties of lac was also established in 1938.

Dr P. K. Bose (1944-53) took over charge of the Institute from December 1944. He visited the UK and the USA in 1948 to contact important sections of lac trade and lac-consuming industries to assess the future prospects of lac in those countries. Dr Bose also led an Indian delegation to New York to finalize the draft of international specifications on lac in 1952.

Dr S. V. Puntambekar (1954-59) took over charge as Director in November 1954. It was during his tenure that two Field Research Stations, one at Damoh (Madhya Pradesh) and the other at Jhalda (West Bengal), and a Regional Testing Laboratory at Gondia (Maharashtra) were started in 1957 and 1958 respectively.

A production unit was started in 1959 as a part of Chemistry Division for popularizing the products developed by the Institute.

Dr M. S. Muthana (1960-62) joined as Director in July 1960. It was during his tenure that a stick-lac processing unit was established in 1962. Two Regional Field Research Stations, one at Mirzapur (Uttar Pradesh) and other at Umaria (Madhya Pradesh), and two Regional Testing Laboratories, one at Balrampur (West Bengal) and other at Daltonganj (Bihar), were established in 1960-61.

Dr G. S. Misra (1963-1969) took over charge as the Director in November 1963. During his tenure the Achievement Audit Committee headed by Professor T. R. Seshadri reviewed the work of the Institute and recommended its reorganization into five Divisions. Consequent upon the abolition of the Lac Cess Committee the Institute was taken over by the ICAR from 1 April 1966.

Mr Y. Sankaranarayanan (1969-1970) took over charge as Director in June 1969. During his tenure some important recommendations of Seshadri Committee were implemented and the Institute was reorganized into five Divisions, viz. Chemistry, Entomology, Agronomy and Plant Genetics, Technology, and Extension.

Dr J. N. Chatterjee (1972-1975) became Director in July 1972. An Achievement Audit Committee under the Chairmanship of Dr M. S. Muthana reviewed the work of the Institute and recommended further expansion of its activities in 1973.

Dr T. P. S. Teotia (1975- to date) took over charge as the Director in November 1975. An Operational Research Project was started in a group of four villages in Ranchi District in 1975. The Institute celebrated its Golden Jubilee in 1976.

CHAPTER 19

# RESEARCH INSTITUTE ON RICE

## CENTRAL RICE RESEARCH INSTITUTE, CUTTACK, (1946)

RICE research in India closely follows the establishment and growth of the Central Rice Research Institute at Cuttack. Before mid-forties, when the institute was established, rice research was conducted in the States. In 1945 the Government of India decided to establish a central institute for rice research from its own funds to deal with all aspects of rice. Dr K. Ramiah, a well-known rice scientist, was appointed the first Director. The Chief Minister of Orissa, the Maharaja of Parlakhemundi and the Director of Agriculture, Dr P. K. Parija, gave generous help to this Institute. In 1946 a 60-ha farm at Cuttack was given to the Institute by the Government of Orissa.

The Institute continued to grow in size, research activities and number of scientists under the guidance of its Directors, viz. Dr K. Ramiah (1946-51), Dr S. Ramanujam (1951-52), Dr N. Parthasarathy (1952-56), Dr R. L. M. Ghosh (1956-58), Dr R. H. Richharia (1959-66), Dr S. Y. Padmanabhan (1966-76) and Dr H. K. Pande (1977-todate). The entire history of the Institute can be divided into three phases. The first phase came to end by 1965. The introduction of the high-yielding, fertilizer-responsive dwarf varieties marked the second phase. The third phase started in 1974 with new concepts developed for transfer of technology under Operational Research Projects and greater emphasis on location and stress-specific technology.

In 1965 the All-India Co-ordinated Rice Improvement Project was initiated with headquarters at Hyderabad under the administrative control of the Director of the CRRI. The Institute was transferred to the ICAR in 1966. Subsequently, the status of the Project Co-ordinator at Hyderabad was raised to Project Director to facilitate speedy decisions and implementation of the programme. The AICRIP was charged with the responsibility of carrying out adaptive research, i.e. to test materials, techniques, etc. pooled from the Institute and other rice research organizations in the country. In addition, a sub-station for rice and fingermillet (*ragi*) was established at Simliguda in 1976 under the Tribal Development Agency programme and two sub-stations for forecasting work of insect pests and diseases at Kalimpong (West Bengal) and Nellore (Andhra Pradesh). A substation for work

on rainfed rice is being established at Hazaribagh in Bihar and is expected to start functioning during 1979.

The Institute at Cuttack has been organized into divisions of Agronomy, Agricultural Engineering, Genetics, Chemistry, Entomology, Plant Pathology, Plant Physiology and Biochemistry. Research is also undertaken in Economics and Statistics. The Director is assisted by administrative and accounts establishments. The total cadre strength of scientists at the Institute is 228, of technical staff 215 and of administrative and supporting staff 274. The Institute has well-developed laboratories and a research farm of 71.63 ha. A substation established by this Institute at Canning, West Bengal, for research on growing rice on saline soils was transferred to the Central Soil Salinity Research Institute in 1969.

During the three decades of the existence of this Institute, important contributions have been made towards the improvement of the rice crop. During the first two decades there was a major shift in policy of breeding by introducing organized cross-breeding to evolve new varieties. In this endeavour the Institute was recognized by the FAO as one of the World centres for the maintenance of rice germplasm registered by the rice-growing countries with that body. The germplasm bank has at present 15 000 collections and the Institute has supplied sizable material to different countries. Some of the varieties evolved at the Institute have been extensively used by the IRRI, Philippines, and the USA in their breeding programmes. The Institute at present co-ordinates the entire national rice germplasm collection, evaluation and utilization, etc. Arrangements are also being made for medium-term storage of the material.

The first organized hybridization programme was initiated by Dr Ramaiah in collaboration with the FAO. Two varietal improvement projects on *japonica-indica* hybridization were taken up, one of which was sponsored by the FAO for the benefit of South and South East Asian countries. The other project was sponsored by the ICAR for the benefit of rice-growing States of the country. The FAO-sponsored project also necessitated organizing international training courses on rice breeding which were held at this Institute in 1952 and 1955. The schemes for popularization of the use of chemical fertilizers in Orissa, and growing a second crop of rice in the State were taken up during 1946-51. The hybridization programme left only one important variety in the field, viz. 'ADT 27', in Thanjavur delta. The culture 'CR 1014' bred at the Institute is today a popular variety in certain

States during *kharif*. In addition, two blast-resistant varieties, viz 'CR 906' and 'CR 907', were also evolved.

During this phase of research 'Ch 45', 'Kaochsiung 22' and 'Shenei' were introduced as early varieties for high elevations. Agronomy of the tall *indica* varieties in terms of time of planting in different seasons, suitable fertilizer level etc. were determined. A package of practices suitable for tall *indicas* was made available to extension workers. Control schedules for major rice diseases were worked out. Physiological specialization of the blast fungus was established and survey of races and forecasting blast outbreaks was initiated. Greater liaison with the States was established. This phase of research was conducted during 1951-66. The development of varieties from *indica-japonica* programme mainly took place during Dr Richharia's time.

During the later part of the tenure of Dr Richharia as Director of the Institute, a new thinking in rice research took place and 'Taichung Native 1' was introduced. Realizing its susceptibility to bacterial blight, 'IR 8' was introduced and it spread fast in the country. The new concept of dwarf plant type provided by these varieties dominated our breeding programmes. At this juncture an All-India Co-ordinated Rice Improvement Project was started. This approach was fully developed during the period of Dr S. Y. Padmanabhan and the co-ordinated rice programme paid rich dividends in identifying the technology and varieties suitable for different areas in the country. Under the guidance of Dr S. V. S. Sastry, Project Co-ordinator, AICRIP, the varieties developed at the Institute and AICRIP, viz. 'Jaya', 'Padma', 'Bala', 'Krishna', 'Ratna', 'Vijaya', 'Jayanthi', 'Sona', 'Vani', 'Kalinga 1', 'Kalinga 2', 'Shakti', 'Supriya', 'Saket 4', 'Akash', 'Prakash' and 'Rasi', were released. These varieties incorporated in them, apart from plant type and high-yielding character, suitability for land types, season etc. 'Ratna', 'Saket 4' and 'Shakti' also possessed tolerance to certain pests, and 'Ratna' was a superior, fine-grain type with excellent cooking quality. Mutation breeding helped favourably alter plant height, duration and yield. 'Jagannath' and 'CRM 13-3241', the varieties which have become popular, are the result of this approach. Emphasis was also given to the management aspects which were found critical for obtaining higher yields, e.g. nitrogen management for different soil types and bio-fertilizers, effective system of forecasting major pests and diseases, time and method of pesticide application, biological control, control of nematodes parasitic on rice, development of simple implements for weeding, application of fertilizers etc. The improved

technology developed at the Institute was carried to the cultivators' fields through national demonstrations.

Transfer of know-how was continued to be made under two regular training courses, i.e. National Training Course for Rice Research and National Training Course for Rice Production of 6-9 and 3 months' duration respectively. The Institute also remained as a recognized centre for the Ph.D. programmes of many universities. In 1974 another major shift in technology transfer took place under operational research projects. Two projects were taken up for rice production and integrated pest control in villages close to the Institute.

In 1977, with the taking over by the present Director, Dr H. K. Pande, the rice research entered a new phase. Eminent rice scientists were invited to a national symposium to examine the reasons for low yield during *kharif* and to finalize a pragmatic approach to tackle the problem. A team of experts of the ICAR (CRRI and AICRIP), State Departments of Agriculture and State agricultural universities of Bihar, West Bengal and Orissa, and other eminent rice scientists of the country and the IRRI, Philippines, toured the three States to examine the bottlenecks in production and suggest measures to overcome them. The recommendations of the national symposium and the team are being examined for early implementation.

## Future Programme

During the Golden Jubilee year of the ICAR, specific problems in various rice research disciplines have been identified, viz. intensification of biochemical research, fixation of priorities, importance of modern post-harvest practices and equipment in minimizing qualitative and quantitative losses, water management in rice fields, variations in major rice pathogens, perpetuation of fungal, bacterial and virus diseases, spread and physiology of rice diseases, physiological and climatological constraints in rice production, nematode problems in upland rice, surveillance, early warning system and forecasting of rice pests and economic threshold of rice pests, control of rice leaf- and plant-hoppers, gall-midge and stem-borers by parasites and predators, and microbial control of rice leaf- and plant-hoppers, gall-midge and stem-borers, which are considered critical in increasing rice production.

Several out-reach programmes with multi-disciplinary teams working on problems of salinity, flash floods, water-logging, upland management, weed control etc. have been formulated. Besides, a substation to work exclusively on rainfed rice is being established in Bihar.

CHAPTER 20

# RESEARCH INSTITUTE ON TOBACCO

## CENTRAL TOBACCO RESEARCH INSTITUTE, RAJAHMUNDRY (1947)

RECOGNIZING the need for well co-ordinated measures for the improvement and development of different kinds of tobacco and the complexity of problems relating to their production, processing and marketing, the Government of India established the Indian Central Tobacco Committee in November 1945. A non-lapsable grant from the proceeds of tobacco excise duty was placed at the disposal of the Committee. The Committee established the Central Tobacco Research Institute, Rajahmundry, in 1947 for fundamental research on tobacco and applied research on cigarette and Lanka tobacco. During 1947-52 the Committee started Regional Research Stations at Vedasandur (Tamil Nadu) for cigar, cheroot and chewing tobacco, at Pusa (Bihar) for *hookah* and chewing tobacco, and at Dinhata (West Bengal) for wrapper and *hookah* tobaccos. The Cigarette Tobacco Research Substation, Guntur, which was started in 1936 by the then Imperial Agricultural Research Institute (IARI) with financial assistance from the Imperial Council of Agricultural Research (ICAR), was taken over by the Indian Central Tobacco Committee (ICTC) in 1947, and started functioning as a Regional Research Station under the Central Institute. During the Second Five-Year Plan a research station was established at Hunsur, Mysore State (presently Karnataka), for evolving control measures for some of the important diseases of flue-cured Virginia tobacco, which had proved to be an impediment in increasing the area under this type of tobacco in that State. The Regional Research Stations at Vedasandur, Pusa, Dinhata, Hunsur and Guntur worked under the administrative and technical control of the Director, Tobacco Research.

Besides the above stations, the Committee financed fully the *bidi* tobacco work undertaken by the Institute of Agriculture, Anand, Gujarat State. The Committee also subsidized the *Bidi* Tobacco Research Substation at Nipani in the Mysore (Karnataka) State, the *Hookah* Tobacco Research Substation, Ferozepore (Punjab), and a number of other schemes run in the States of Andhra Pradesh, Assam, Kerala, Madhya Pradesh, Tamil Nadu (Madras), Maharashtra, Orissa, Karnataka (Mysore), Uttar Pradesh and West Bengal. These research stations and schemes functioned under the administrative control of the

respective State Governments and other authorities, but the programme of research was carried out with the advice of the Institute Director.

With the abolition of the Commodity Committee, the Central Institute and the regional research stations attached to it came under the control of the ICAR with effect from October 1965.

An area of 42.1 ha was acquired during 1977 at Kandukur, Prakasam District, Andhra Pradesh, and a research station is proposed to be established there. Research work on agronomical, pathological and breeding aspects has been started at Kandukur during 1978-79.

An area of 6.07 ha was granted free to the Institute by the Andhra Pradesh Government at Rajahmundry in a pollution-free area for construction of the Central Institute buildings in that location, shifting from the existing pollution-affected area.

All-India Co-ordinated Research Project on Tobacco was initiated in 1970, and in 1971 work was started at the main centres Rajahmundry, Anand, Bangalore and Pusa and subcentres Guntur, Hunsur, Dinhata, Nipani and Kavali; the centres at Bangalore, Nipani and Kavali being under the respective agricultural universities. In 1976 Shimoga replaced Bangalore centre, and in 1978 Venkataramanagudem replaced Kavali subcentre, and Kandukur was taken up as an additional centre.

The Institute had the following distinguished scientists as its Directors: Dr B. S. Kadam (1947-54), Dr N. R. Bhat (1955-58), Dr G. S. Murty (1958-63), Dr D. M. Gopinath (1964-72) and Dr N. C. Gopalachari (1972 onwards).

During the tenure of Dr B. S. Kadam, flue-cured tobacco varieties 'Harrisoin Special' and 'Chatham' were introduced. Topping was found to improve the body of the upper leaves without deterioration in leaf quality and give 10 to 15% increased yields over untopped plants.

During the tenure of Dr N. R. Bhat, flue-cured tobacco varieties 'Delcrest' and 'Virginia Gold' were introduced and released. Chewing tobacco variety 'DP 401' was released for Bihar State.

Dr G. S. Murty was responsible for improvement in barn design. Control measures were evolved for pests and diseases.

During Dr D. M. Gopinath's tenure improved flue-cured tobacco varieties 'Kanakaprabha' and 'Dhanadayi' were released.

During the tenure of the present Director, Dr N. C. Gopalachari, several improved varieties have been evolved. A package of practices for growing Burley tobacco in the agency tracts of East Godavari District was formulated. An integrated system of pest and disease control was also evolved.

CHAPTER 21

# RESEARCH INSTITUTES ON TUBER CROPS AND FRUITS

## CENTRAL POTATO RESEARCH INSTITUTE, SIMLA (1956)

THE Central Potato Research Institute was established in August 1949 at Patna. Later, in 1956, the headquarters of the Institute was shifted to Simla, and Patna became a regional station of the Institute. During 1956-58 new laboratory buildings and glass-houses were added. Five additional Potato Experimental and Trial Centres at Babugarh (Uttar Pradesh), Rajgurunagar (Pune, Maharashtra), Jullundur (Punjab), Shillong (Meghalaya) and Ootacamund (Tamil Nadu) were established. In 1963 a Wart-Testing Station at Darjeeling and a Nucleus Seed Production Station at Fagu (Himachal Pradesh) were started, thus expanding the infrastructure and field of activity of the Institute still further. The disease-free seed-production programme was expanded in 1969 for production of sizable quantities of disease-free seed stocks for further multiplication and making it available to the growers. Under this scheme a second unit was added in 1969 at Jullundur, a third unit at Daurala in 1971 and a fourth unit at Kodaikanal in 1975. Two more units at Patna and Shillong are envisaged in the near future. In 1971 an All-India Co-ordinated Potato Improvement Project under the control of the Central Potato Research Institute was started by the ICAR. The Project has 17 associated centres. The Institute has been progressively strengthened during the successive Five-Year Plans.

With its well-equipped laboratories, a good library, and fields in the hills and the plains, the CPRI is devoted to basic and applied research on potato. Evolution of improved and high-yielding varieties, suited for different potato-growing areas of the country, production of sizable quantities of disease-free seed for further multiplication, evolving and recommending improved cultural and manurial practices and for combating potato diseases and pests in different regions, and extending the technology so developed to the farmer's fields through education and training, form the major part of the activity of the Institute.

### ACHIEVEMENTS

The most perceptible impact of the Institute's work has been the

sizable increase in area and production as well as per unit yield of the crop in the country during the last 26 years (1949-50 to 1976-77). Other notable achievements of the Institute are: (*i*) evolution and release of a set of nearly 16 high-yielding, disease-resistant varieties for different potato-growing regions of the country; (*ii*) evolution of the Seed Plot Technique with which it has now become possible to produce disease-free seed of quality comparable with hill seed, in the plains of India, where nearly 90% of the area under potato is situated; (*iii*) survey, identification and control measures of several serious diseases such as late blight, charcoal and brown rots, viruses and mycoplasmal diseases hitherto unknown and unrecorded in India; (*iv*) recommendation of a package of practices for improved potato production for different potato-growing regions in the country; and (*v*) creating an awareness about the potentialities of this crop as a second bread as also an earner of valuable foreign exchange through exports for seed and ware purposes.

### CONTRIBUTIONS OF SCIENTISTS

The scheme for the establishment of the Institute took shape under the guidance of Sir Herbert Stewart, the then Agriculture Advisor to the Government of India and Sir Pheroz M. Kharegat, then Secretary, Ministry of Agriculture. Dr B. P. Pal, Dr S. Ramanujam, Dr Pushkarnath and Dr R. S. Vasudeva took an active interest and participated in the formulation of the scheme and in the establishment of the Institute. Among them the name of Dr S. Ramanujam, the then Second Economic Botanist, IARI, needs special mention. He was appointed as Officer on Special Duty by the Government of India in 1946 to chalk out and establish the Institute. His contribution included drawing up of the detailed scheme, its operational aspects, site selection, recruitment and selection of the initial team of researchers such as botanist, agronomist, pathologist and entomologist. Dr Pushkarnath was already holding the post of Botanist, with headquarters at Simla. For the other three positions, Dr Mukhtar Singh, Dr M. J. Thirumalachar and Dr B. P. Chaudhuri were selected

During a span of more than 40 years of his active research life, Dr S. Ramanujam carried out research on fundamental and applied aspects on a variety of crops such as rice, oilseeds, pulses, potato, etc. He was the founder-Director of the Institute, having worked earlier as Officer on Special Duty from 1946 onwards to establish the Institute. He was responsible for organizing the Institute in its formative years

and putting it on a strong foundation. Apart from organizational problems and creation of the basic infrastructure for the Institute, during his tenure the base for the variety evolution programme and seed-production system in the country was laid. Even after his retirement from active service in 1966, Dr Ramanujam has continued to take keen interest in the work and growth of the CPRI.

Dr Pushkarnath's tenure as Director was the longest (September 1951 to September 1952, May 1956 to February 1969). He was associated with the potato breeding work even before the establishment of the Institute. He did valuable work on sterility and incompatibility in potato and on production of disease-free seed potato in the plains of India. He published two monographs on varieties of potato in subtropics, besides over 100 research papers on various aspects of the crop. He received the Rafi Ahmed Kidwai Award in 1968 in recognition of his contributions to research on potato.

Associated with the Institute as Agronomist right from its inception (April 1969-October 1975), Dr Mukhtar Singh's work on interrelation between seed size, spacing and fertilizers, water management, effect of growth-regulators on plant growth, dormancy breaking of freshly harvested potato, post-harvest treatment and storage management has been commendable. He started the programme on the direct, cumulative and residual effect of fertilizers in different crop rotations both in the hills and plains as well as in his studies on intercropping and multiple-cropping patterns with potato. He also made many innovations by suggestions on fabricating agricultural tools and implements, such as the smoke-screen which has helped the growers to protect their potato against frost, a crust-breaker for use on ridges, and a seed-treatment chamber for breaking dormancy of freshly harvested tubers.

Dr Nagaich has been responsible for the initiation and organization of research in potato pathology and production of virus-free nucleus stocks of potato. His work on some of the viruses, hitherto unrecorded in India, and on mycoplasmal diseases of potato has been of pioneering nature. He has reinforced the activities of the Plant Pathology Division by adding the Tissue Culture and Bacterial Pathology laboratories.

The Institute is now the pivotal centre of potato research, not only in India but in South-East Asia. It has developed fruitful lines of collaboration and co-operation with the International Potato Centre, Lima, Peru, and the Scottish Plant Breeding Station, Edinburgh. The Institute also actively collaborates with the national institutes

like the IARI, New Delhi; Bhabha Atomic Research Centre, Bombay; the Central Food Technological Research Institute, Mysore; and with all the State Departments of Agriculture, National Seeds Corporation, the agricultural universities etc., where potato is an important prevalent or potential crop.

## CENTRAL TUBER CROPS RESEARCH INSTITUTE, TRIVANDRUM (1963)

The Central Tuber Crops Research Institute was established in July 1963 for the intensification of research on the improvement of tuber crops (other than potato) at Sreekaryam, near Trivandrum.

The main objectives of the Institute are:

1 Breeding high-yielding, better-quality, disease- and pest-resistant varieties of tuber crops, viz. cassava (tapioca), sweet-potato, *Dioscorea*, *Amorphophallus*, *Colocasia*, *Coleus*, etc.

2 Determination of best standards of culture, manuring, soil and water management, storage etc.

3 Investigation of the physiological, biochemical and technological aspects of the crop.

4 Survey, investigation and control of major diseases and pests which affect these crops.

5 Production, maintenance, multiplication and distribution of disease-free planting materials of improved varieties.

6 Dissemination of knowledge on the improved techniques of crop production in relation to tuber crops.

The Government of Kerala provided 20.64 ha of free land at the time of establishment of the Institute for an experimental farm. Under the Fourth Five-Year Plan a provision of Rs 0.86 million was made for the construction of the laboratory-cum-office building in the farm. The construction of these buildings with a total plinth area of 2 188 $m^2$ was completed in June 1976. The building complex consists of a main office-cum-laboratory building, one farm house, insectory and two glass-houses.

During the fifth Five-Year Plan research activities were strengthened. As the area of the farm and the working space in the buildings were not adequate, action was taken to acquire more land for the farm and an additional area of 22 ha has been added since 1974.

### IDRC Cassava Project

A Cassava Research Project financed by the International Deve-

lopment Research Centre, Canada, was started in July 1976 with the objective of strengthening and broadening the cassava-research capacity of the Institute and establishing viable and economic techniques for disseminating cassava-research findings to small farmers. The major programmes contemplated are: development of a plant introduction and international testing unit which will enable CTCRI to obtain and evaluate new germplasm; the creation of post-harvest utilization team which will examine problems of drying, storage, processing and utilization of cassava; to undertake intensive work on the field of Tissue Culture to produce the planting material of new varieties on a commercial scale within the shortest possible time and availability of limited land; setting up an operational research unit which will initially conduct agro-economic survey of cassava cultivation and its role, both as a monoculture and as a component of multiple cropping system to examine the possibilities for developing new systems based on the CTCRI research findings which will lead to higher farm income; organization of training programme for the CTCRI professional staff at other cassava research institutes (CIAT, IITA, MARDI, EAAFRO) and for the Ph.D. and M.Sc. candidates, State Government extension workers and farm leaders at the CTCRI.

A total provision of 361000 Canadian dollars has been made by the IDRC for the implementation of the Project for a period of 3 years. The programmes under the Project have already been taken up. A centre of the CTCRI for testing of germplam materials has been established at Bhubaneshwar in Orissa State and an Operational Research Project has been located at Vattiyoorkavu Panchayat in Trivandrum District in Kerala. Under the training programme, training is being given to extension officers as well as farmers.

## Contributions of Directors

Mr M. J. Deshmukh, who was the Chief Potato Development Officer at the CPRI, Simla, joined the CTCRI, Trivandrum, on 11 July 1963 as its first Director. He obtained planting materials of different tuber crops from the University of Kerala, where a tapioca research scheme funded by the ICAR was functioning. He established the office of the CTCRI in Trivandrum City. In spite of limitations of staff and other facilities, he did the spadework to establish the Institute.

Dr M. L. Magoon joined the Institute as Director on 24 April 1964. He was an eminent scientist whose work and findings on Irish potato were well known, especially the nature of chromosome pairing

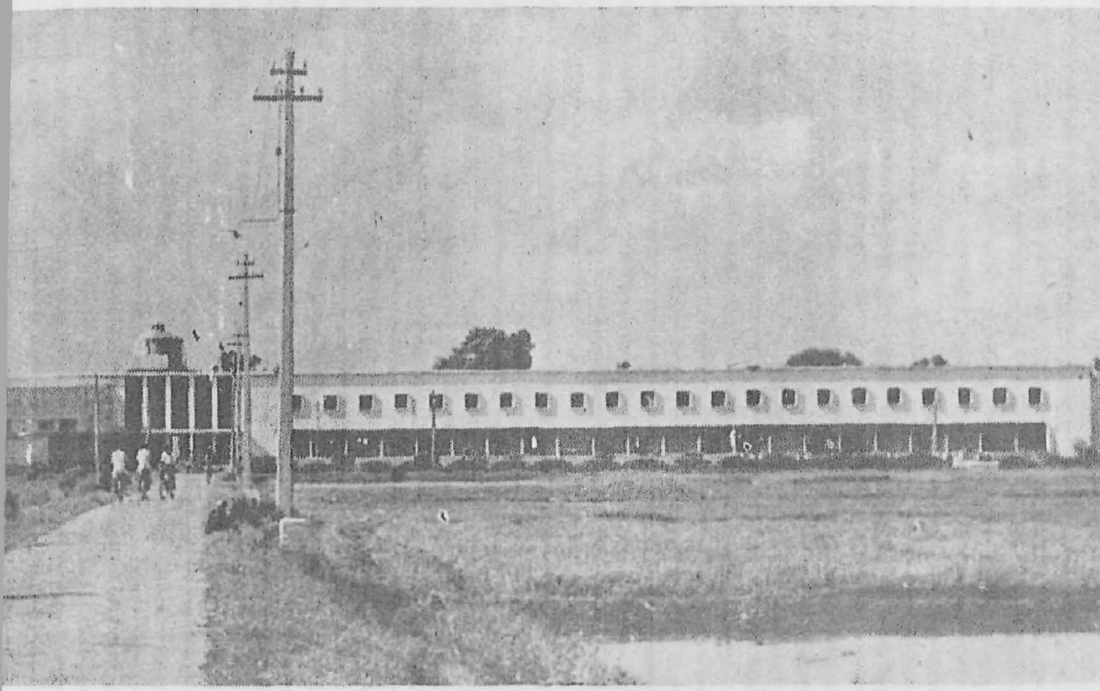


Fig. 18. Central Rice Research Institute, Cuttack

Fig. 19. All-India Co-ordinated Rice Improvement Project—laboratories and administrative office

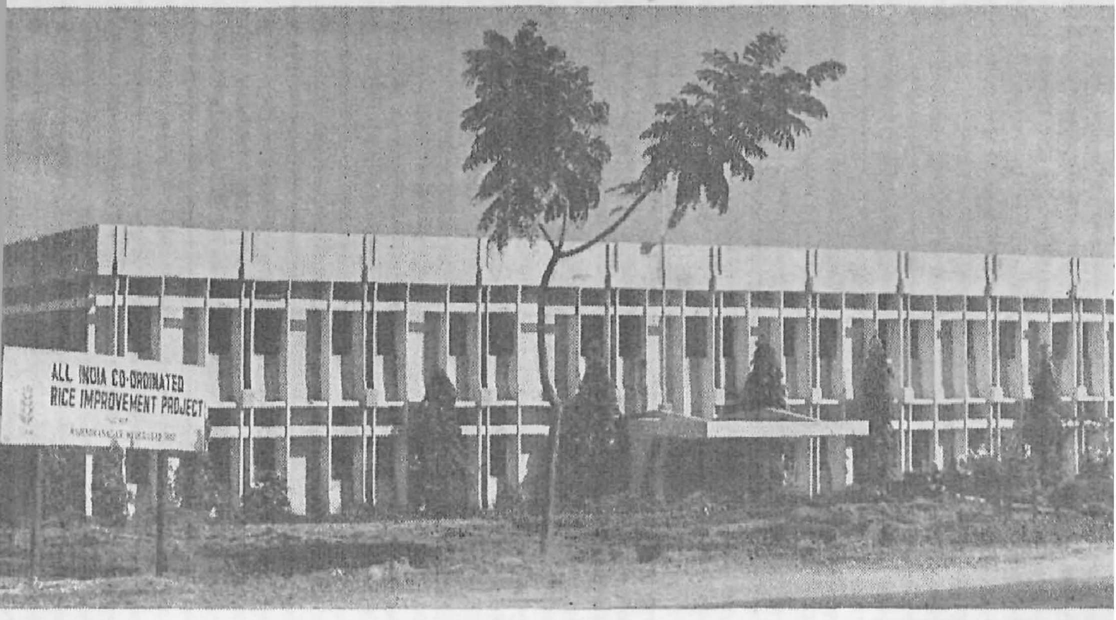


Fig. 20. The main laboratory building of the Central Potato Research Institute, Simla

Fig. 21. Central Tuber Crops Research Institute, Trivandrum

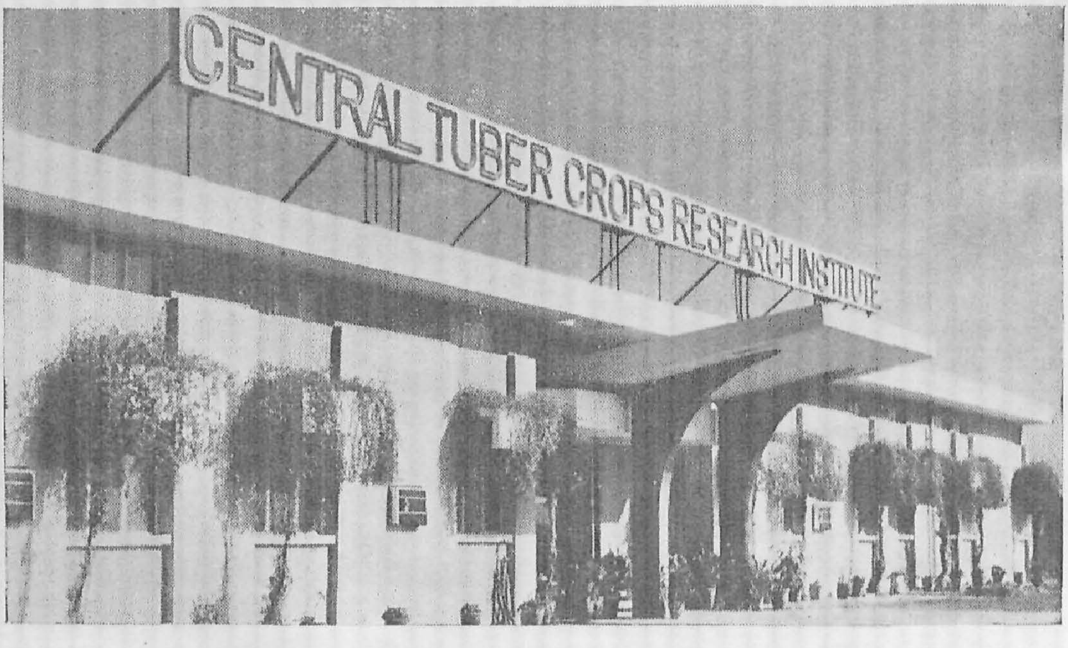


Fig. 22. A healthy potato crop at the CPRI station, Jullundur

Fig. 23. Central Soil Salinity Research Institute—rice crop on reclaimed soil

at meiosis in the interspecific hybrids in the genus. After associating himself with other tuber crops like cassava and sweet-potato, he made valuable contributions within a short period of 6 years in the field of plant improvement and cytogenetics. During his period as Director of the Institute, three improved hybrids of cassava and two of sweet-potato were released, out of which one cassava hybrid, 'H 165', is considered to be an early maturing one. His findings on the cytogenetical behaviour of tuber-bearing plants threw light on the causes restricting the fertility in different tuber crops.

Dr N. Hrishi joined the Institute as Director on 17 April 1972. The new building of the Institute was constructed and inaugurated in 1976. Post-harvest technology section was organized for conducting investigation on storage, processing and utilization of cassava and other tuber crops. Cassava research has been further strengthened with the support of the IDRC. An Evaluation and Testing Centre was established in Orissa, and an Operational Research Project at Trivandrum.

The Institute has been recognized as a centre for advanced research, and currently six in-service personnel and one full-time research scholar are doing research for their Ph. D. degrees. The work done at the Institute has received international recognition. International agencies like IDRCTPI, CIAT and IITA have proposed collaborative research projects.

Two improved varieties of tapioca were released in 1976. These varieties are now being widely cultivated and accepted by the farmers. Two improved varieties of sweet-potato are in the pre-release stage and are being tested in Minikit trials.

ACHIEVEMENTS

*Varietal improvement through introduction.* Genetic materials of different tuber crops, viz. cassava, sweet-potato, *Dioscorea*, *Colocasia*, *Xanthosoma*, *Alocasia* and *Amorphophallus*, from within and outside the country, are being collected to build up a germplasm bank.

The exotic collections of tapioca include those from Madagascar, Tannanarive, Brazil, Fiji, Malaysia, Sri Lanka, Nigeria, Columbia etc. These are being utilized in the breeding programme.

*Evolution of improved varieties.* A number of outstanding hybrids which recorded higher yields consistently in the farm and in multi-location trials in the farmers' fields, conducted in a wide range of agroclimatic conditions have been isolated. Besides being prolific yielders, these hybrids excel over many of the local varieties in their economic value such as field resistance to cassava mosaic, scale insect and red mite and

also in size, shape and colour of tuber as well as low HCN content and high starch content. Of these, three hybrids, viz. 'H 97', 'H 165' and 'H 226', have been released for cultivation in 1971 and two hybrids in 1977, viz. 'H 2304' ('Sree Sahya') and 'H 1687' ('Shri Visakham'), which give mean yields of 44.99 and 44.05 tonnes/ha respectively. The tubers of 'H 1687' have high carotene content (Vit. A 466.1 U/100 g).

Similar hybridization programmes conducted on sweet-potato enabled the release of two high-yielding, better-quality hybrids of this crop, viz. 'H 41' and 'H 42', which were also capable of giving yields higher than the local varieties. Other high-yielding early varieties like 'H 268', 'H 633' and 'H 620' are in advanced stage of evaluation.

Progenies have been raised from the open-pollinated seeds of sweet-potato, and the seedlings have been screened for agronomic attributes. Two open-pollinated progenies, 'OP 1' and 'OP 2', are in the pre-release stage. These varieties are being tried for their performance in various agro-climatic conditions under minikit trials. They are planted in the farmers' fields in all the districts of Kerala along with local varieties for evaluation.

'Kassibugga' and 'Narkatia' are two colocasia selections which have given mean yields of 16.01 and 15.1 tonnes/ha respectively. Both have good cooking and keeping qualities.

To overcome the difficulty in the availability of planting materials of the released varieties for distribution to the farmers as well as those of the other promising ones for various experiments and field trials, techniques for rapid multiplication of the planting materials are being tried. A rapid propagation technique has been developed for cassava. Sprouting of half-node cuttings has been induced with the help of mist chamber, by which 647 plants and 3 235 planting stakes (20-cm long) could be obtained from a single plant of cassava in 1 year as against 10 plants and 100 planting stakes with the conventional method. Thus the propagation rate of cassava could be increased 32 times compared with the conventional system.

## INDIAN INSTITUTE OF HORTICULTURAL RESEARCH, BANGLORE (1967)

The proposal for the establishment of the Indian Institute of Horticultural Research was approved in early 1967. Dr G. S. Randhawa, who was then Deputy Agricultural Commissioner with the Government of India in the ICAR, was appointed as the founder-Director of this Institute. The Government of Karnataka gave 24.28-

ha National Hortorium at Hessaraghatta for the establishment of the Institute as its nucleus and later on gave another 202.34 ha.

During the Fourth Five-Year Plan, when the Institute was established, 47 scientists were recruited. In the Fifth Five-Year Plan two Horticultural Experiment Stations, viz. Citrus Experiment Station, Gonicoppal, and Horticultural Experiment Station, Chethalli, were handed over to the Institute by the Government of Karnataka. Subsequently, a Krishi Vigyan Kendra and Trainers' Training Centre were established at the Horticultural Experiment Station, Chethalli. A scheme was also started for production of virus-free citrus budlings in mandarin for supply to citrus growers in mandarin-growing areas of the country, e.g. Karnataka, Kerala, Tamil Nadu and north-eastern region including Sikkim.

The Central Mango Research Station of this Institute was started at Rehmankhera, Lucknow, on 24 November 1972 for conducting researches on north Indian mango varieties.

Several new schemes like the All-India Co-ordinated Projects on Biological Control of Crop Pests and Pesticide Residues were started with the aid from the Department of Science and Technology.

During the Sixth Five-Year Plan, the IIHR proposes to intensify research on horticultural crops in important tribal areas of the country. It is proposed to have a 365-ha Experimental Station at Godhra, in Gujarat and 365-ha Experimental Station at Ranchi and Netarhat in Chotanagpur area of Bihar. A UNDP Project on the establishment of a Centre of Advanced Studies in Tropical Horticulture has been sanctioned at the IIHR in collaboration with the University of Agricultural Sciences, Bangalore.

### ACHIEVEMENTS

*Improvement of grapes.* Work on grape breeding was started at the IIHR, Hessaraghatta, Karnataka, soon after the formal establishment of the Institute in 1968. The main objectives of this work are to develop high-quality, high-yielding and disease-resistant varieties for the table, juice, raisin and wine-making. A large number of crosses have been made, involving the promising varieties introduced from grape-growing regions of the world and our existing commercial varieties, viz. 'Anab-e-Shahi', 'Bangalore Blue' and 'Thompson Seedless'. Nearly 3 500 seedlings (2700 hybrids, 560 selfed and 270 open-pollinated) were grown in the field for evaluation during the period from 1972 to 76. Rigorous screening of this material has resulted in the selection of four promising hybrids, viz. 'C 36-16', 'B 11-3', 'C 2-5'

and 'B 42-23'. All these hybrids are under further tests and will be released shortly.

*Standardization of agro-techniques in banana.* A dose of 180 g N, 32 g $P_2O_5$ and 22 g $K_2O$ per plant per year was found to be the best, giving the maximum fruit yield of 42.0 to 53.0 tonnes/ha when planted at a spacing of 2.4 m × 1.8 m. There was no response of phosphate and potash fertilizers on the fruit yield.

There was 8.00 to 12.00 tonnes/ha more fruit yield under the spacing 2.4 m × 1.8 m. The above observations were further supported by leaf analysis for N, P and K.

*Chemo-taxonomy in* Annona *and* Citrus. Phylogenetic studies were attempted in the genus *Annona.* This technique has given a good insight about species relationships and taxonomic status of cultivars classed under *A. squamosa*, which are actually hybrids of *A. squamosa* and *A. cherimola*.

More than 70 taxa of citrus were screened and this study has been able to throw much light on their phylogenetic affinities.

*Growth-regulators in grape and pineapple.* In grape a dose of 15 or 20 ppm GA at full-bloom stage and 60 ppm at fruit-set stage has been standardized for optimum looseness in the clusters and increase in berry size.

Application of 50 ppm GA at 5-6 days after full bloom to 'Gulabi' grape decreased the shot berry formation (a major defect in this cultivar) to a negligible percentage.

Application of 50 ppm NAA was the most beneficial for reduction of post-harvest berry drop of 'Cheema Sahebi' grapes when applied one week before harvest.

In pineapple ethephon (100 ppm) was the best for induction of flowering under Bangalore and Malnad conditions.

*Chemical regulators of growth and flowering in mango.* Use of 2-(chloroethane) phosphonic acid (CEPA) for flower induction and control of biennial bearing in mango.

Studies conducted from 1970-75 at the Institute farm as well as in farmers' fields have established for the first time that ethephon (200 ppm) could be used to induce heavy flowering and fruiting during the 'off' year in the biennial variety 'Langra'. Consecutive application of 200 ppm ethephon for 3 years did not show any decline in the vigour and yielding ability of the treated 'Langra' mango trees.

*Induction of flowering and cauliflory in mango by ethephon.* Ethephon at 500-1000 ppm could be successfully used to induce flowering

in 2½ and 3½-year-old juvenile, nucellar mango seedlings of different polyembryonic varieties. Foliar application of higher concentration of ethephon (400 ppm) induced profuse cauliflory in 40-month-old juvenile nucellar mango seedlings besides inducing flowering in the terminal buds. Thus ethephon could be profitably used for early evaluation of hybrid seedlings in mango-breeding programme.

These studies showed that both in mature trees and juvenile seedlings, ethylene acts as a flower-inducing hormone either *per se* or in combination with other growth hormones.

The IIHR has also made a significant contribution to the family planning programme of the country by domestication and improvement of *Dioscorea*, a medicinal plant, leading to its commercial cultivation.

CHAPTER 22

# RESEARCH INSTITUTES ON SOIL AND RELATED PROBLEMS

## CENTRAL SOIL SALINITY RESEARCH INSTITUTE, KARNAL (1969)

THE Central Soil Salinity Research Institute was established during the Fourth Five-Year Plan in 1969 at Karnal to conduct research on problems relating to reclamation, management and utilization of salt-affected soils for crop production. The Institute has a research station at Canning, West Bengal, which forms a nucleus for catering to the research needs of coastal salt-affected soils.

Research at the Institute is conducted mainly in its three divisions: Soils and Agronomy, Genetics and Plant Physiology, and Engineering. The Institute also has an Extension Unit for carrying the results of research from the laboratories to the farmers' fields. Besides, the co-ordinating units of the two all-India co-ordinated projects for research on 'Water Management and Soil Salinity' and 'Use of Saline Water in Agriculture' are also located at this Institute. An Operational Research Project to test and demonstrate the applicability of the new technology for the reclamation of alkali soils at farmers' fields was sanctioned by the ICAR in 1974, and the work is being continued in seven villages. A Consultancy Service functioned at this Institute from 1976 to provide technical advice to those desirous of reclaiming salt-affected soils.

### OBEJCTIVES

The objectives of the Institute are as follows:

1 To collect information on the extent, characteristics, genesis and classification of the salt-affected soils in different parts of the country.

2 To study salt and water dynamics in irrigated agriculture, to conduct detailed hydrological surveys and to provide suitable criteria for surface and subsurface drainage for controlling the salt and water balance in the soil.

3 To study the factors governing the chemical composition of the surface and underground waters, and evolve methods to check deterioration and pollution of these waters, and to utilize waters of different qualities for agricultural purposes.

4 To find physiological mechanism associated with salt tolerance of crops and to evolve crop varieties tolerant to saline-sodic conditions.

5 To develop technology for the reclamation and utilization of salt-affected lands in the country.

6 To serve as a centre for postgraduate education and training in the field of soil salinity and related subjects.

7 To collaborate with agricultural universities and other Central and State organizations in the development of research, training and extension programmes.

ACHIEVEMENTS

Studies have been carried out to characterize and classify salt-affected soils by studying soil profiles located in Uttar Pradesh, West Bengal, Haryana, Andhra Pradesh, Kerala and Bihar States by laying due emphasis on genetic profile characteristics.

The scientists of the Institute have been able to study and collect considerable research information on various methods of reclamation of alkali soils such as chemical, agro-technical, biological and hydro-technical including engineering aspects which altogether form a package of practices suited to specific areas. The relative effectiveness of different amendments like gypsum, pyrites, phospho-gypsum, press-mud, sulphuric acid, basic slag etc. used for reclamation of alkali soils has been evaluated. The minimum dose of gypsum required for reclamation has been worked out, depending on the soil texture, crop and related factors.

Numerous studies have been undertaken to find out crops and varieties along with their cultural and agronomic practices which can be successfully adopted in the alkali soils. Experiments have revealed a remarkable decrease in exchangeable sodium percentage (ESP) and pH of the highly sodic soil owing to the growth of rice, and therefore inclusion of rice crop as the first crop in the rotation has proved very helpful in reclamation. The use of older seedlings and higher plant population than those used in normal soils resulted in higher rice yields.

A large number of varieties of important crops have been screened for their tolerance to different levels of soil salinity and alkali conditions. In rice, among the early maturing group 'Pusa-2-21' has given the highest yield, whereas among the late-maturing group 'Jaya' and 'IR 8' have outyielded others. Out of a large number of varieties of wheat screened for tolerance to alkaline soil conditions, 'HD 1982', 'WH 157', 'WL 711', 'HD 1553' and 'HD 2009' proved better than others.

Barley varieties 'DL 70', 'DL 36', 'BS 105', 'K 153', 'K 198' and 'BHS 24' have shown higher grain-yielding ability than the rest. *Bajra* materials 'PHB 13', '23 $D_2$A' × 'J 41', '71 A' × 'DIII', and 'Hybrid 3' and 'Hybrid 4' have given promising yields under mild alkaline soil conditions.

The drainage and hydrologic aspects of alkali soils with and without reclamation have been studied in greater detail and the results indicate that the drainage methods are location specific. An experiment on subsurface drainage taken up in the sodic soil of the research farm has revealed that the subsurface is neither desirable nor workable, and the solution lies in the wise manipulation of the excess rain water during heavy rains. Nearly 60% of the total rain water could be stored in the bunded rice fields and 25 to 30% in the dug-out ponds in the low-lying area. This could minimize the drainage needs of the area.

Ground-waters have been surveyed in Jind and Karnal districts of Haryana and maps prepared. Lysimetric studies were carried out to determine the effect of different qualities of irrigation water on soil properties and crop growth. At higher salinity of irrigation water (8 000 micromhos/cm and above), wheat-grain yield was much higher in sand dune soil compared with medium textured soil. Experiments have shown that hazardous effect of boron occurring in toxic amounts in irrigation waters and soils could be minimized with the use of gypsum. Attempts have been made to modify the standards for water quality.

The Institute has developed a package of practices for the reclamation of alkali soils, some of the essential components of which are: (*i*) proper bunding and land levelling, (*ii*) application of suitable amendment in right quantity and in right manner, (*iii*) adequate application of fertilizers and manures along with zinc application, (*iv*) choice of proper crops and varieties and cropping sequence such as growing of high-yielding varieties of rice as the first crop in *kharif* followed by wheat in *rabi* season and growing of *dhaincha* as green-manure crop during summer, if sufficient facilities of irrigation water are available, (*v*) use of appropriate cultural and agronomic practices, and (*vi*) proper water-management practices etc. The effectiveness of the technology for reclamation of alkali soils has been successfully demonstrated on a large number of farmers' fields in Haryana, Punjab and Uttar Pradesh.

Dr D. R. Bhumbla was the first Director of this Institute and he remained in position from March 1969 to March 1974. It was under his leadership that the CSSRI was established and the experimental farm was laid out. The research problems which needed immediate attention were identified and several research projects initiated. Within a short

period the Institute's scientists under the leadership of Dr D. R. Bhumbla brought out very useful research results on reclamation of alkali soils. Being encouraged by the applicability of these research findings on reclamation of alkali soils at the farmers' fields, the State of Haryana was the first to establish Haryana Land Reclamation and Development Corporation. Necessary action was taken for the construction of residential accommodation and for the finalization of the other building requirements of the Institute. During his period the Research Station at Canning was transferred to the control of the CSSRI from the Central Rice Research Institute, Cuttack. Before its transfer, the main emphasis at this Research Station was on breeding of rice varieties for coastal saline soils, but after its transfer to CSSRI a multi-disciplinary approach was introduced. In addition to his duties as Director, Dr Bhumbla also acted as part-time Co-ordinator for the Co-ordinated Project for Research on Use of Saline Water in Agriculture.

Dr J. S. P. Yadav took over as Director after Dr Bhumbla, in 1974. The Institute developed further under his leadership. In addition to the duties as Director, Dr Yadav continues to act as Co-ordinator of the Co-ordinated Project for Research on the Use of Saline Water in Agriculture.

## CENTRAL SOIL AND WATER CONSERVATION RESEARCH AND TRAINING INSTITUTE, DEHRA DUN (1974)

The Central Soil and Water Conservation Research and Training Institute, Dehra Dun, came into being on 1 April 1974. This was the culmination of a series of developments starting from 1947. In May 1947, Messrs D. C. Kaith, R. J. Kalamkar, D. J. Gandhy, S. P. Raychaudhuri, A. T. Sen, M. H. Khan and A. G. Raiz were sent to the USA for 1 year, to acquaint themselves with the techniques of soil and water conservation and to give a report on the ways of their application under Indian conditions. These officers submitted a report entitled 'A soil conservation and land utilization programme for India' on 30 April 1948. In the foreword to the report, Dr H. H. Benett, Chief, Soil Conservation Service, United States Department of Agriculture, stated that the plan and programme presented in the report should be put into effect as soon as possible.

Soil Conservation Centre at Dehra Dun and the Desert Afforestation Research Station at Jodhpur started functioning as Soil Conservation Branch and Desert Afforestation Research Station of the Forest Research

Institute, Dehra Dun, respectively. The Central Soil Conservation Board, which started functioning in 1954, took over from the Forest Research Institute the control of the Desert Afforestation Research Station established at Jodhpur. The Soil Conservation Branch set up in the Forest Research Institute was transferred to the Central Soil Conservation Board of the Government of India, Ministry of Food and Agriculture, in May 1954. It was also decided that research on soil conservation should be conducted on a regional basis and linked up with the demonstration of approved soil-conservation practices and training of technical personnel.

The credit for establishing the Soil and Water Conservation Research, Demonstration and Training Centres in India under the Central Soil Conservation Board goes to the late Dr J. K. Basu, Director of Soil Conservation (Agron.), Mr M. S.V. Rama Rao, Director of Soil Conservation (Engng), Mr D. C. Kaith and Mr U. S. Madan, Directors of Soil Conservation (Forestry). A number of specialists from Soil Conservation Service, USDA, under the TCM Aid Programme were associated with the above-mentioned Indian scientists in developing the Soil and Water Conservation Organization, Research and Training Programme, viz. Messers A. M. Hedge (leader of TCM team), W. M. Nixon (Agronomist), W. S. Speer (Agronomist), M. L. G. Singnell (Engineer), B. Muirhead (Engineer) and M. H. Tayler (Training).

The Central Soil Conservation Board had also the opportunity of getting expert advice from Dr C. G. Kellog, Assistant Chief (Soil Survey), USDA, and Dr Don A. Williams, Chief Administrator, Soil Conservation Service, USDA.

Accordingly, late in the First Five-Year Plan and early in the Second Five-Year Plan the Central Soil Conservation Board established a chain of nine Soil Conservation Research, Demonstration and Training Centres at Dehra Dun, Chandigarh, Bellary, Ootacamund, Kota, Vasad, Agra and Jodhpur. The Desert Afforestation and Soil Conservation Centre at Jodhpur developed into the Central Arid Zone Research Institute in 1959 with the collaboration of the UNESCO. A Centre was set up at Chatra in Nepal to take up research on soil-conservation problems of the watershed of Kosi River Valley Project. A Centre at Ibrahimpatan/Hyderabad in the semi-arid red soil region was established in the Third Five-Year Plan in 1962.

The pioneering work of establishing individual research centres including selection of research farms and drawing up of plans and programmes of soil and water conservation for the region was done by the

Officers-in-Charge of the centres, viz. Dr R. S. Gupta, Dehra Dun; Dr N. Patnaik, Kota; Dr K. G. Tejwani, Vasad; Dr Ch. Krishnamoorthy, Bellary; Mr C. P. Bhimayya, Ootacamund; Mr I. I. Erasmus, Chandigarh; Mr A. B. Phadke, Agra; Mr A. R. Bhaskaran; Ibrahimpatan; Mr Gurmel Singh, Hyderabad; and Mr A. P. Joseph, Chatra.

During the Third Plan the Government of India reorganized the Soil Conservation Division in the Ministry of Agriculture and redesignated the Senior Director as Advisor and entrusted the responsibility of co-ordinating the Soil and Water Conservation Development, Research and Training Programme to him. Dr R. V. Tamhane was appointed the first Soil Conservation Advisor. During the Third Plan these Centres were strengthened to some extent. In spite of increasing emphasis on soil and water conservation, it was unfortunate that the soil and water conservation research and training programmes were made non-Plan during the annual Plan years from 1966-1969.

After the reorganization of Agricultural Research and Education in India, all the Soil Conservation Research, Demonstration and Training Centres of the Government of India except Chatra were transferred to the ICAR on 1 October 1967. The ICAR gave institutional structure to the existing Soil Conservation Research, Demonstration and Training Centres and redesignated the Soil Conservation Research, Demonstration and Training Centre, Dehra Dun, as the Central Soil and Water Conservation Research and Training Institute with headquarters at Dehra Dun with effect from 1 April 1974. The six Soil Conservation Research, Demonstration and Training Centres, viz. Chandigarh, Kota, Vasad, Agra, Ootacamund and Bellary, came under the administrative control of the Central Soil and Water Conservation Research, Demonstration and Training Institute, Dehra Dun. The Centre at Hyderabad became the headquarters of the All India Co-ordinated Research Project for Dryland Agriculture with responsibility to carry out the research programmes of the soil-conservation research also. At the headquarters of the ICAR, the Deputy Director-General (SAIE) looked after the activities of the soil and water-conservation research. Dr J. S. Kanwar was the first Deputy Director-General to be followed by Dr D. R. Bhumbla. Both of them and Dr N. Patnaik, Assistant Director-General (Soils), gave dynamic guidance in bringing up soil conservation to the forefront. Dr K. G. Tejwani was the first scientist selected by the ICAR and entrusted with the leadership of Soil Conservation Research in 1970 and made the first Director of the Institute in 1975.

## Contributions of Scientists

Late Dr J. K. Basu, one of the Directors of Soil Conservation under the Government of India, Ministry of Food and Agriculture, was primarily responsible for planning the research programme of soil and water conservation in different centres. Mr M. S. V. Rama Rao, another Director of Soil Conservation, provided guidance in drawing up the soil and water conservation research programme relating to engineering. Mr U. S. Madan, Director of Soil Conservation, guided in preparation of the soil and water-conservation research programme in forestry and grasslands. Dr J. S. Kanwar pushed the idea of co-ordinating research and training programmes in soil and water conservation. The scheme for providing institutional structure to the soil conservation research, demonstration and training centres was also initiated by him. During the tenure of Dr D. R. Bhumbla, the Dehra Dun centre was redesignated as the Central Soil and Water Conservation Research and Training Institute. Dr Bhumbla vigorously advocated the cause of soil and water-conservation research and training in India. Dr K.G. Tejwani, the present Director, has the distinction of giving practical shape to the research programmes not only at the Soil and Water Conservation Research Centres of the ICAR but also elsewhere in the country.

## Achievements

The research centres of the Central Soil and Water Conservation Research and Training Institute, Dehra Dun, at Bellary, Agra and Kota have developed useful practices for soil and moisture conservation which help to increase the yield of rainfed crops.

At Bellary for deep black soils and similar regions with annual rainfall of 500-600 mm in the States of Karnataka, Andhra Pradesh, Maharashtra and Tamil Nadu broad-based terraces on lands with 1 to 2% slope—and by application of crop technology such as use of improved varieties, crop geometry, optimum sowing time for different crops, fertilizer use and vertical mulching—the yield of rainfed crops has been increased up to 2-3 tonnes/ha/annum. One farm pond for every 8- to 10- ha catachment area is recommended in deep black soils of Karnataka State. The harvested run-off water stored in a pond can be recycled to increase the yield of *rabi jowar* grain from 435 kg/ha without irrigation to 1 367 kg/ha with application of one irrigation at knee-high stage.

The Research Centres at Ootacamund and Chandigarh have evolved soil-conservation and water-management techniques by which soil erosion and run-off can be reduced, and soil fertility of land maintained

for maximum sustained production.

In gentler slopes with the help of graded bunds, and in steep slopes with the help of bench terraces and by appropriate crop technology, the yield of rainfed crops has been increased to 5-6 tonnes/ha/annum in the Doon Valley.

The Institute and its research centres have endeavoured to select grasses and trees suitable for different land resource regions which will not only protect the wastelands but will also produce fodder, fuel, fibre and timber. In the ravine lands of Gujarat, bamboo (*Dendrocalamus strictus*), teak (*Tectona grandis*) and shisham (*Dalbergia sissoo*) have been very successfully introduced. Fast-growing *Eucalyptus* spp. and *Acacia* spp. have been successfully tried and introduced at various research centres in denuded and eroded areas. At Ootacamund *Eucalyptus globulus* (blue gum) could be raised profitably (at a cost of about Rs 750/ha) on farm boundaries and marginal lands unfit for regular cultivation.

It has been possible to utilize large areas lying waste along the banks of torrents in the Doon Valley to grow *Dalbergia sissoo* and *Acacia catechu* for fuel, *Chrysopogon fulvus* for grass and *Eulaliopsis binata* for fibre.

Techniques for gully classification, gully-erosion control, and reclamation of gullies for fodder and fuel plantation have been developed by the Soil Conservation Research Centres at Kota, Vasad and Agra. As a result of researches carried out at these research centres the Government of Rajasthan, Gujarat and Uttar Pradesh have taken up a number of ravine-reclamation projects on the banks of Chambal, Mahi and Yamuna rivers and their tributaries. Gujarat farmers have reclaimed the ravine lands and put them under productive agricultural uses. Cash crop like tobacco is being grown on such lands. Such reclaimed land is also being used for raising citrus gardens.

The Institute has developed technology for stabilization of landslides through an integrated approach of structural and vegetative measures in Nalota Nala on Dehra Dun-Mussoorie road.

Regular training programme in Soil and Water Conservation for gazetted officers and assistants is conducted at the Institute at Kota, Bellary, Ootacamund and Hazaribagh (DVC).

The Institute has undertaken two operational research projects. One of these projects is in backward hill district of Tehri-Garhwal, where a watershed of 370 ha has been managed for various land uses, such as rainfed agriculture, irrigated agriculture, horticulture, fodder-fuel plantations, water-resource development, bench-terraces improvement, and

also prevention of erosion along roadsides. A project has been undertaken at Chandigarh Centre in the catchment of Sukhna lake, where it has been successfully demonstrated that it is possible to reduce the sediment rate and peak discharges in highly degraded and denuded Siwalik regions. The water resource developed by construction of ponds has been recycled for providing supplemental irrigation to the fields. Both these projects have been executed with the active co-operation of the farmers.

## NATIONAL BUREAU OF SOIL SURVEY AND LAND-USE PLANNING, NAGPUR (1976)

The National Bureau of Soil Survey and Land-Use Planning started functioning independent of the IARI with effect from August 1976. In 1978 it moved to its permanent location, Nagpur.

Scientific study of Indian soils may be considered to have begun with the founding of the Geological Survey of India in 1846, when emphasis was laid on soil geology. The recognition of four major soil groups, viz. alluvial, black, red and laterite, by Leather (1878) by the turn of the last century in different regions was an important development in the concept of soil distribution and mapping. Since then, sporadic surveys were carried out with limited objectives by the Agricultural Chemistry Sections of the Department of Agriculture in the provinces and States. Genetic studies on soils were started in late thirties and early forties but soil mapping, correlation, classification and interpretation did not receive emphasis. It was, however, recognized that scientifically prepared soil maps would be useful for land-use planning and developmental programmes. The importance of survey of lands in command areas to determine their suitability for irrigation and location of problem areas for subsequent reclamation was also realized.

This perhaps prompted the then Imperial Council of Agricultural Research to seek the expert advice of Dr A. B. Stewart of the Macaulay Institute for Soil Research, Aberdeen, who in 1946 recommended systematic mapping of soils through field studies supplemented by laboratory data. Accordingly, reconnaissance survey of a few districts was taken up for designing fertilizer-use experiments on different soils. Implementation of soil-survey scheme in two parts was also recommended earlier (1940) by the *Ad-hoc* Committee of the Soil Science Committee of the ICAR. The first part dealing with collection, critical examination and collation of all the available soil data in the country was imple-

mented and a report issued (Report No. 73, ICAR). The second part of the recommendation, viz. carrying out soil surveys, was taken up much later.

Under the Indo-US Technical Co-operation Project (TCM), a soil fertility and fertilizer-use scheme was launched in 1953 when soil survey was carried out at six selected centres in different regions. In the mean time some of the State Departments of Agriculture had established soil-survey units for carrying out detailed soil surveys in irrigation-command areas. In the absence of co-ordinating agency at the centre which could take up standardization of techniques, adoption of uniform nomenclature, imparting training etc., the information collected was of limited use.

### All-India Soil and Land-Use Survey

At this juncture Dr F. F. Rieckens, a soil specialist of the USA, was invited by the Government of India in 1954 to advise on soil-survey work in India. Giving effect to recommendations of Dr Rieckens, the All-India Soil Survey Scheme was initiated in 1956 at the IARI with four Regional Centres at Delhi, Calcutta, Nagpur and Bangalore to carry out reconnaissance soil survey, correlate and classify soils and prepare small-scale soil maps. This scheme was integrated with the Land Utilization Survey Scheme of the Central Soil Conservation Board and thus the All-India Soil and Land-Use Survey Scheme came into being in 1958. The scope of work was expanded and more stress was laid on time-demanding detailed soil survey in catchment area of the major river valley projects. In 1966, although the All-India Soil and Land-Use Survey Organization functioned as a division of the IARI, it remained under the technical control of the Department of Agriculture, Government of India.

In 1969, however, as a result of the reorganization of the ICAR, a major portion concerning research aspects of soil survey, i.e. Pedology classification and correlation, was transferred to the ICAR-IARI whereas the remaining portion dealing with detailed surveys in River Valley Project area was retained in the Department of Agriculture.

### National Bureau of Soil Survey and Land-Use Planning

Realizing the importance of soil surveys in research planning and developmental programmes, a national status was accorded by strengthening and converting the All-India Soil and Land-Use Survey Organizations into a National Bureau in 1974 in the Fifth Plan. Two additional

centres were sanctioned, one for the north-eastern hills region and the other for the semi-arid desert region of Rajasthan and Gujarat States. The Bureau started functioning independent of the IARI from August 1976 with temporary headquarters in the IARI Campus. In 1978, with the availability of accommodation, the headquarters was shifted to its permanent location at Nagpur.

*Objectives.* The nature of work undertaken by the Bureau consists of both basic and applied research and educational activities. Besides, consultancy work in the use of soil-survey data for specific purposes is also undertaken.

Conduction of standard soil surveys in different regions and preparation of soil maps in different scales from *tehsil* through districts and States and eventually of the country on 1 : 1 million scale by progressive abstraction and compilation, correlation, classification and interpretation of soil data to help utilization of soil and land resources as best suited to their potential are the important tasks assigned to this organization.

Research projects on pedological and edaphological aspects of the identified bench-mark soils forms the core programme of the Bureau.

Analysis, evaluation, standardization and interpretation of modern techniques like remote sensing including air-borne and space-borne imageries (LANDSAT) forms yet another part of the work plan. Feasibility studies are also undertaken to know the utility of these techniques for soil-survey work.

*Research projects.* These are designed in the light of the objectives and nature of work enumerated above.

A project on reconnaissance soil survey, correlation and classification is in progress at all the centres on a continued basis. Data generated in this project are being progressively abstracted and compiled for updating the soil map of India.

Soil taxonomy developed by the Soil Conservation Service of the USDA is being adopted for calssifying soils. However, certain modifications in the system may become necessary for its use under Indian conditions. To test the rationale of the system and suggest modifications, a project is in progress at all the centres.

Soil-physiographical relationships may be pronounced in some areas and subdued in others. A well-established relationship of this kind at macro and micro level will provide a good key for map interpretation, designing initial legend and delineation of boundaries. Hence research is underway on this aspect in selected areas of different regions to understand such relationships.

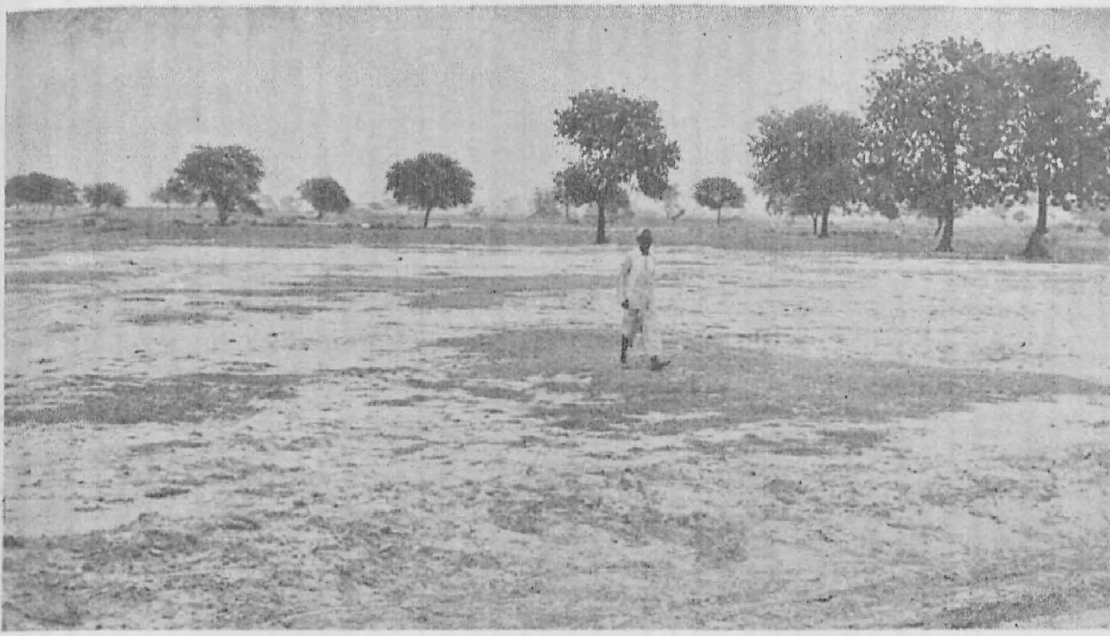


Fig. 24. Barren alkali land of a farmer in the operational research project area

Fig. 25. First crop of rice after initiating reclamation process on the same barren alkali land

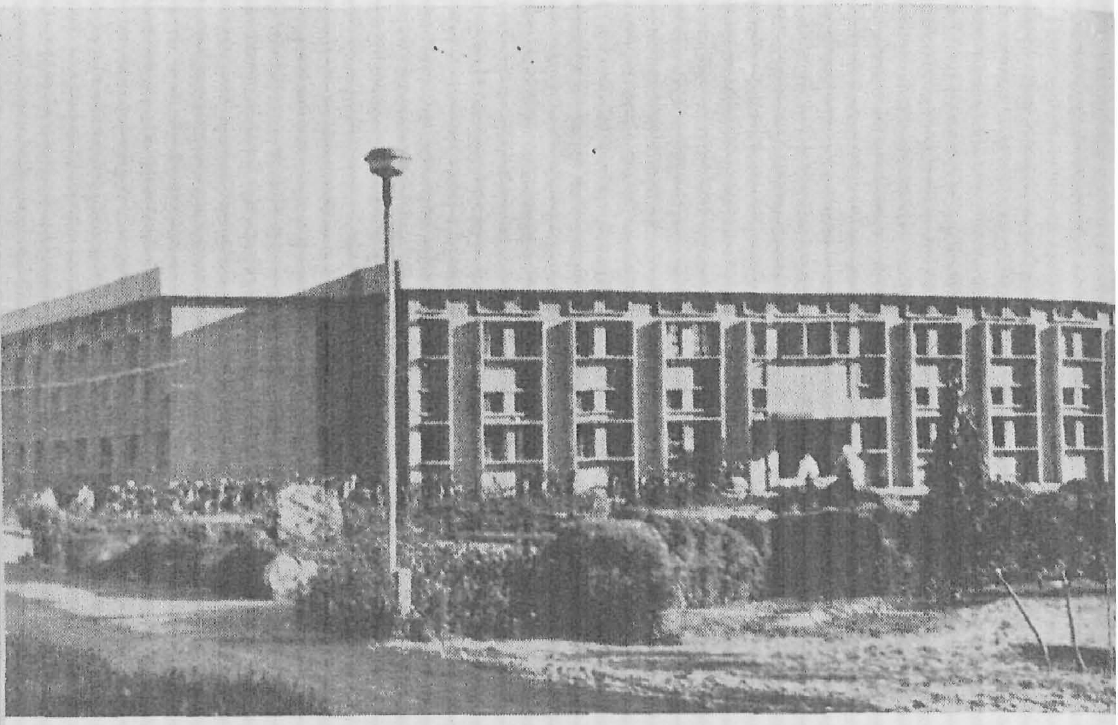


Fig. 26. Central Arid Zone Research Institute, Jodhpur — a view of the soil-water-plant relationship laboratories of the Institute

Mositure-intake rate and its retention in soils are important properties which determine the choice of crops and varieties and the frequency and number of irrigations. They are critical in semi-arid areas, especially where crops are grown on stored moisture. Hence studies on hydrological properties of soils mapped in particular areas form yet another research project.

Soils respond selectively to different crops and management inputs. *Evaluation of soils for productivity and crop adaptability is important for* land-use interpretation. As on Operational Research Project for studies on soil-management levels, crop responses were started first at Delhi centre, extending to other centres as a part of the ICARGolden-Jubilee year programme.

Inter-disciplinary, inter-institutional and collaborative research projects on specific problems are also undertaken by the Bureau.

Agricultural Resource Inventory Survey Experiment (ARISE) was planned in collaboration with the Space Application Centre of the ISRO, Ahmedabad, to study the feasibility of using air-borne imageries for crop identification and censusing in the Anantpur and Patiala Districts. Similar experiments on other aspects using various data-generating systems derived from air-borne and space-borne pay-loads are also planned to be undertaken.

A project on the pedogenetic studies of red and black soils in a type area near Hyderabad is in progress in collaboration with the ICRISAT.

ACHIEVEMENTS

During the Plan periods between 1956 and 1969, emphasis was laid on *soil survey of the catchment areas of the major river-valley projects*, to provide information to State agencies, so as to enable them to take up immediate soil-conservation measures in priority areas to avoid siltation of reservoirs. In addition, reconnaissance soil survey was also conducted in other areas. About 10.2 million ha were covered by standard soil survey during the above period and nearly 300 soil-survey reports with soil maps were issued to the various user agencies.

During 1969-78 progressive reconnaissance soil surveys were carried out on extensive scale, selecting areas on the basis of priorities and problems, viz. drought proneness, backwardness, integrated rural development and other research and development activities, covering an aggregate area of about 24 million hectares in Haryana, Punjab, West Bengal, North Eastern Region, Maharashtra, Karnataka, Andhra Pra-

desh, Gujarat and Goa Territory.

As a part of the resource-inventory preparation for the districts selected for integrated rural development, surveys were completed in Chandrapur and Wardha Districts of Maharashtra, Cannanore District in Kerala, and Tumkur District in Karnataka. Three kinds of maps, viz. soil, present land use, and suggested land use, are generally incorporated into the resource-inventory document. Lands recommended for agricultural crops (mono as well as double crops), cash crops, fibre and oilseed crops, grasslands and forest lands of teak, bamboo and mixed forests are indicated. In Wardha emphasis is more on agriculture, as forest areas are limited. Soils recommended for wheat, cotton, *jowar*, *arhar*, chilli and groundnut as well as areas suitable for banana cultivation are shown. In Cannanore District recommended land use has largely taken into account the plantation crops on the hill slopes, and rice in the broad and narrow valleys. Soil survey was also carried out in Kutch (Gujarat), Rajkot and Surendra Nagar Districts of Gujarat for land-irrigability evaluation as requested by the Narmada Tribunal.

While the district reports are under compilation, brief reports and soils maps at *tehsil* levels were furnished to the user agencies. About 100 soil-survey reports were issued during 1969-78.

In collaboration with the Indian Metereological Department, the soil maps of Maharashtra and Karnataka were superimposed on detailed rainfall-analysis maps and areas of different intensities of drought proneness from low to high were delineated.

A joint experiment was initiated in collaboration with the Indian Space Research Organization for utilizing the Remote Sensing Techniques for crop censusing and making an inventory of agricultural resources in Anantapur District of Andhra Pradesh and Patiala District of Punjab. A report covering two *talukas*, viz. Madaksira and Hindpur, has already been issued.

A pilot project for determining the feasibility of using multiband imageries for resource study was undertaken in collaboration with Space Application Centre, Department of Space, Ahmedabad, for an area near Pune, Maharashtra. Photo imageries were interpreted, checked with ground truth data, and thematic maps in respect of geomorphology, soil and land use were prepared.

### Future Plan

Programmes relating to soil survey, preparation of soil maps and

land-use plans which help to decide the choice of crops (agricultural, horticultural, plantation etc.) suited to different agro-ecological regions will be taken up in Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, Rajasthan, Maharashtra, Gujarat, Madhya Pradesh, Karnataka and Andhra Pradesh. Crop-potential maps, productivity studies under different levels of management, soil moisture and textural relationships for crop manipulation will figure among the items of study.

Resources survey will be taken up in the Bundelkhand region (Uttar Pradesh and Madhya Pradesh) and north-eastern region (all the States and Union Territories) to demarcate problem and potential areas, and initiate research and development programmes relating to soil conservation, water-use management, dryland farming etc. On the basis of surveys conducted in Kutch (Gujarat), suitable sites will be identified for starting pilot studies on land reclamation and development.

## CONTRIBUTIONS OF SCIENTISTS

Till the National Bureau was established in 1976, the All-India Soil and Land-Use Survey Organization was headed by the Chief Soil Survey Officer. Dr S. P. Raychaudhuri was appointed the first Chief Soil Survey Officer in 1958. His chief contribution was in providing a sound foundation to the organization. Soil survey was relatively a new discipline. It was difficult to find trained personnel to man the tasks. Dr Raychaudhuri through his untiring personal efforts and with a few senior scientists arranged training programmes and in a short time created a band of devoted workers, most of whom are still in the organization. Dr Raychaudhuri not only started the organization with centres at distant places but also maintained a steady progress of work both in respect of quality and quantity.

With the retirement of Dr S. P. Raychaudhuri in 1961, the responsibility of the organization fell on the shoulders of Soil Correlator of the southern region, Dr S. V. Govinda Rajan. He was instrumental in starting a Training Centre at Nagpur, introducing for the first time air-photo interpretation techniques for soil surveys, revising the existing soil map of India, issuing a new Soil Survey Manual, and initiating the Rural Engineering Survey scheme. The organization derived stability during his tenure, soil survey techniques were standardized and excellent liaison was maintained between the Central and State organizations.

On superannuation of Dr Govinda Rajan, Dr R. S. Murthy took over as the Chief Soil Survey Officer in December 1971. In 1976 he became the Director of the Bureau. During his tenure soil survey,

which had the status of only a division of the IARI, assumed a national status and importance. Under his leadership, research projects of regional, national, inter-institutional, interdisciplinary and multi-disciplinary importance were undertaken. Joint collaboration projects and consultancy work were also undertaken. At the same time the tempo of progressive soil surveys in different States was maintained. Modern tools including air-borne and space-borne imageries were introduced for the first time to test the feasibility of their use in soil survey. Infrastructure laboratory and field-work facilities were increased. New divisions of Pedology, Remote Sensing and Land Use were added. Two additional centres were created to cater to the heavy demand on surveys. In short, comprehensive leadership in scientific, administrative and organizational work was the main feature.

CHAPTER 23

# RESEARCH INSTITUTES ON ARID ZONE, GRASSLAND AND FODDER

## CENTRAL ARID ZONE RESEARCH INSTITUTE, JODHPUR (1959)

IN 1958 the Government of India requested the UNESCO to review the situation in the desert regions of India and suggested the organization of desert research in the country. Mr C. S. Christian, CSIRO, Australia, was deputed as the UNESCO Advisor. He recommended the reorganization of the Central Research Farm at Jodhpur into an institute to conduct research on problems relating to aridity in arid and semi-arid tracts in the different regions of the country. Consequently, in October 1959 the Station was reorganized as the Central Arid Zone Research Institute (CAZRI). In April 1966 the administrative and technical control of the CAZRI was transferred from the Ministry of Food and Agriculture to the ICAR.

### OBJECTIVES

The CAZRI has the following major objectives :

1 Identification of the problem through integrated survey involving geomorphic, geo-hydrological, pedological, biological, climatic and sociological aspects over a cartographic overlay and to suggest measures for the overall development of the arid and semi-arid regions of India.

2 Evolution of silvicultural, grassland and pasture management technologies under different soil, rainfall and biotic conditions, and to achieve the optimum use of the natural resources.

3 To explore the underlying principles of soil-water-plant environment relationships for their gainful utilization through newer technologies to augment plant production in arid and semi-arid areas.

4 Development of technologies for harnessing wind power and solar energy for human benefit with special reference to prevailing agro-climatic conditions of desert biome and its modulation over time.

5 To make an inventory of the animal, insect, vertebrate pests, wildlife and livestock resources and to devise suitable measures for their management so as to enhance the productivity of the arid lands.

6 To study the available human resources in the arid and semi-arid areas and to suggest ways and means for their optimum utilization.

7 To expose the population to recent technologies and their eco-

nomic benefits and monitor gains of the newly evolved plant and animal husbandry methods through operational research projects.

8 To impart short-term training to the farmers and extension agencies for the desert-development purposes.

ORGANIZATION

The Institute started with five divisions to conduct basic and applied research. Later two more divisions were added, based on the report of two successive Achievement Audit Committees to meet the expanded research needs. These divisions relate to Basic Resources Studies, Plant Studies, Animal Studies, Wind-Power and Solar-Energy Utilization Studies, Soil-Water-Plant Relationship Studies, Economics and Sociology, and Extension and Training.

The main centres of the following all-India co-ordinated research projects of the ICAR are located at the Institute : Dryland Agriculture, Improvement of Millet, Research on Water Management, Rodent Control, and Operational Research Project on Arid Land Management and Drip and Sprinkler Irrigation.

Research projects are organized on multi-disciplinary, problem-oriented co-ordinated basis. The functions of the various divisions are stated below.

The Division of Basic Resources Studies is mainly engaged in integrated surveys of various natural resources, viz. climate, soils, landscape, water, vegetation, and socio-economic aspects of the arid and semi-arid regions, so as to assess the production potentials of these regions in the light of the prevailing constraints and to suggest ways and means for the optimum utilization of the resources.

The Division of Plant Studies conducts research on problems of utilization, management, improvement and reclamation of vegetation and crop resources to evolve packages of practices for increasing the yield of crops, grasses, horticultural plants and forest lands.

The Division of Animal Studies is engaged in studies on the physiological adaptive mechanism of desert-livestock species, particularly sheep and their nutrient utilization under stressful conditions, and conducts ecological studies on pests, particularly rodents, to develop control measures.

The Division of Wind-Power and Solar-Energy Utilization conducts investigations in collaboration with other disciplines on water balance of plant communities under different agro-climatic and soil conditions, dynamics of soil moisture and its movement in stabilized and

shifting sand dunes, climatology in relationship to crop production, mechanism of wind erosion and methods of preventing it. Equipments and technology for solar-energy and wind-power utilization are being developed.

The Division of Soil-Water-Plant Relationship Studies undertakes research on the physiology of plants adapted to the arid and semi-arid environments, plant-nutrient availability, erosional hazards and crop production, maintenance and build-up of soil fertility, physical conditions of the soil and their moisture retention, micro-organism population, efficient use of limited water under arid conditions for producing crops economically, varietal and cultural trials, fertilizer application, weed control and cropping patterns etc. to evolve suitable technology for the management of arid lands consistent with maintenance of soil productivity and ecological balance.

The Division of Economics and Sociology undertakes socio-economic surveys of the settled and nomadic human resources of the arid areas. The scope and economics of different farm and livestock enterprises, and evaluation of the improved agricultural practices developed at the Institute on the basis of input-output relationships have also been undertaken.

The Division of Extension and Training undertakes extension work and carries out demonstrations on farmers' fields, and prepares literature for the benefit of extension workers and other agencies engaged in the development of the arid zone.

## Achievements

A scientific assessment of natural resources (climate, land, water, vegetation, livestock, human population, etc.) has been made by the CAZRI through multi-disciplinary integrated surveys and specific detailed studies, the results of which are reported here.

*A climatic analysis of the Indian arid zone.* A detailed delineation of the arid areas in the country, based on Thornthwaite's moisture indices has been carried out. Areas with moisture-index values of less than 40 were identified as the arid zone. Of the total area (0.32 million $km^2$) categorized as arid zone, 62, 20, 5 and 4% lies in Rajasthan, Gujarat, Punjab and Haryana, respectively; north-western India thus constituting almost 90% of the total arid-zone area in the country. Among climatic parameters, low mean annual rainfall (100 to 450 mm), coupled with high coefficient of variability (40 to 70%) and its skew distribution, extreme variation of diurnal and annual temperature, together

with high evaporation have been considered characteristic of the Indian arid zone.

*Arid-zone soils, their characteristics and properties.* As a part of the integrated surveys carried out by the Institute, the characteristics and properties of western Rajasthan soils have been studied in detail. Dunes are a dominant formation in 30.6% and a subdominant associate in 34% of the total area. Light brown sandy soils, associated with a few to many dunes, occur in 34 and 30.6% of the area respectively. Brown light loams, grey brown loams, soils with hard pan, sierozems, alluvial soils with dunes and other soil types identified occupy 1.7, 13.6, 5.9, 1.6 and 6.8 % of the area respectively.

*Salinity-alkalinity problem.* Considerable work has been done on salinity-alkalinity problem obtaining in the arid zone. The occurrence of salinity has been found to be associated with major salt basins, flood plain of the Ghaggar and the Luni systems, recent rise in saline ground water, and irrigation with saline sodic waters. The area occupied by each of the above situations was estimated as 431, 2 434, 559 and 1 722 $km^2$, representing 0.22, 1.24, 0.28 and 0.88 % of the total area of western Rajasthan respectively.

*Land-use pattern in the arid zone.* A study of land-use pattern shows that forest land not available for cultivation, other uncultivated land excluding fallow lands, fallow lands and net area sown, accounted for 1.88, 23.85, 19.30, 11.72 and 43.25 % area of the Indian arid zone in 1970-71, compared with 21.54, 15.10, 10.62, 6.60 and 46.14 % area, respectively, of India as a whole. There are hardly any Class I and Class II lands in the arid region. Class III, Class IV and Class V lands occupy 27, 16 and 1.2% of the area respectively. The most predominant land-capability class encountered in the Indian arid zone is Class VI, occupying 45% of the area. These are the lands which are highly susceptible to wind erosion, particularly in areas receiving less than 200 mm rainfall. The rocky and saline lands occupy hardly 1.97 and 0.6% area respectively.

As revealed by the integrated surveys covering an area of 64 140 $km^2$ (32.7% of arid Rajasthan), the present land use is inconsistent with land-use capability dictated by the inherent soil characteristics. Only 46 to 60% of the area in the arid zone of Rajasthan is suitable for arable farming, the rest (21 to 24%) is suitable for permanent pastures. It has been suggested that pediments exposure, which constitute 5.6 to 8.8% of the area, is eminently suited for silvi-pastural cover.

Based on the reconnaissance, detailed reconnaissance or detailed

survey carried out in an area of 84 893 km$^2$ (26.52% of the total arid area), covering some of the districts of western Rajasthan (Bikaner, Jodhpur, Jalore, Barmer and Nagaur), 10 Mapping Units or Major Land-Resources Units (MLRU) have been standardized.

*Other notable achievements.* The CAZRI has the unique distinction of having inter-disciplinary research projects, including those in physical, biological and social sciences. However, a few main achievements are detailed below.

The ecology of different species of rodents and their bait preferences, bait shyness, seed consumption, dose response to lethal chemicals and optimum reason for control have been evaluated. Technology has been established for control of field rodents, which costs only Re 0.30-45/ha.

A technology involving twice weekly watering of desert sheep has been evolved, which ensures 50% saving in stock drinking water, besides increasing digestibility coefficient of dry matter-cell-wall constituents. Desert goat has been identified to be a much hardier animal than desert sheep.

Researches conducted at this Institute have led the successful fabrication of solar water heater, solar oven, solar cabinet dryer, and solar distillation kits, etc. These gadgets cost around Rs 300-500 only and can be made use of by the rural population.

Effective methods of control of white grub and termites have been evolved. Diosgenin—an important raw material for the production of steroid hormones and oral contraceptives—has been isolated from an indigenous plant, *Balanites roxburghii*. From *Euphorbia antisyphilitica* and *Cymbopogon martinii*, Condelilla wax and an essential oil have been isolated respectively. Among spineless cacti, *Opuntia* has been identified as the most suitable species for forage purposes, giving green forage yield of 7.3 tonnes /ha in the establishment year to 30 tonnes/ha in the third year.

Considerable work has been done on agronomic practices influencing the yield of dryland crops, in particular pearlmillet. Of late, clusterbean and mothbean have attracted the attention of research workers. Work on cropping systems, including intercropping systems, water harvesting, soil and moisture conservation measures, etc., which have a direct bearing on crop production, has been in progress at the Institute for quite some time. Highlights of research on crop-production practices are presented here.

*Cropping systems for drylands.* Cropping systems research has re-

vealed that crop production on drylands could be stabilized through crop diversification, inter-cropping of legumes in perennial desert grasses, and other dryland crops (*bajra, moong*, sunflower, castor) and recycling of run-off water in the event of drought. *Cenchrus ciliaris*, clusterbean and castor have been identified as potential crops, capable of imparting stability to crop production on drylands. In a good rainfall year (500 mm) with an extended rainy season, double crop system of pearlmillet followed by mustard was found to be the most remunerative.

*Water-harvesting systems*. An innovative technology involving water harvesting from bare catchment, collection of run-off water in a pond, and recycling of run-off water has been developed. Studies have indicated that run-off of 15.8 to 26.6% of the total rainfall could be harvested in good-rainfall years. In the studies on inter-plot water harvesting (run-off farming), it was revealed that with a catchment to the cultivated area ratio of 0.5, each hectare of cropped area received 23 to 100 mm of run-off as irrigation water from the catchment in addition to 117 to 528 mm from direct rain. The additional low-tension water results in increasing and stabilizirg crop yields, mitigating the risk of crop failure, saving inputs of production, and making the best of every rain drop that falls on the farm. A modification of the inter-row water-harvesting system, by providing two micro-catchments instead of one, for inducing more run-off, has been suggested. Dusting of wetted ridges, provided between two ditches in the Modified Inter-Row Water Harvesting (MIRWH) system, with bentonite clay was found to result in inducing more run-off than the conventional inter-row water-harvesting system.

*Soil and moisture-conservation measures*. Earlier studies revealed that stubble mulching and wind-strip cropping are the basic remedies for the maladies caused and accentuated by wind action. In a recent experiment a 1-m-wide strip of pearlmillet planted as a shelter barrier against the prevailing wind direction reduced the wind speed by 63% and increased the yields of summer okra and cowpea by 190 and 90% respectively. To cut down losses owing to deep percolation, a technique of partial moisture barrier incorporation has been developed at the Institute. The technique works very well when the barrier and run-off concentration systems are combined.

*Arid-zone forestry*. Out of about 250 species introduced in the Institute from different foreign countries, a few species of *Eucalyptus* and *Acacia* and a few others have been found to be extremely promising.

Silvi-pastoral studies indicated that cultivation of sown pasture in the inter-rows of trees (5 m × 5 m) gave dry-grass yield of 700-2 000 kg/ha without affecting tree growth. Lopping schedules of top-feed species such as *Prosopis cineraria* and *Ziziphus nummularia* have been standardized. *Eucalyptus viridis* was the most promising in respect of oil. Similar was the case with exotic species from Arizona, viz. *Simmondsia chinensis* (jojoba) for wax.

Silvicultural studies indicated that a leguminous tree, *Dichrostachys glomerata*, an introduction from Israel which is not only quick growing but is extremely hardy and resistent to drought and frost, is very suitable for introduction in Indian arid zone. It spreads itself by throwing sucker and its leaves can be used as fodder and are highly nutritive. Similarly, *Dichrostachys nutans*, which also regenerates well, holds a great promise for stabilization of sand dunes and reclamation of land slides and ravines.

*Colophospermum mopane*, introduced from South Rhodesia, has self-regenerated profusely from seed dispersal under arid conditions. Further studies of this species are in progress.

*Afforestation and wind-erosion control.* Wind erosion is one of the major hazards in arid zone especially for agriculture. So one of the important techniques to control the spread of desertic conditions is afforestation, including establishment of windbreaks and shelterbelts to provide mechanical obstacles to the free sweep of wind and reduce its velocity. Another important measure is the stabilization of shifting sand dunes. The CAZRI has demonstrated this technology by stabilizing shifting sand dunes of over 1 000 ha. Experiments to find out suitable design and tree species for effective wind-breaks are being conducted. Measurements on wind reduction at different distances, micro-climatic changes and effects of these belts or crop yields and dust movement are being carried out.

*Arid zone horticulture.* The fruit crops suitable for the arid zone environment have been identified under dryland conditions, with suitable water harvesting. Jujube (*Ziziphus mauritiana*), pomegranate (*Punica granatum*), guava (*Psidium guajava*) and custard apple (*Annona squamosa*) can be successfully grown. With supplementary irrigation, sour lime (*Citrus aurantiifolia*) and amla (*Emblica officinalis*) may be grown. Under the conditions of assured irrigation facility, fruits like mulberry, *phalsa*, grape, datepalm, sweet-orange and papaya can be grown profitably. Detailed cultivar evaluation with respect to *ber* and datepalm, and evaluation of suitable water-harvesting system for growing of *ber*

fruits are in progress. An improved technique for establishing *ber* orchards has been developed.

FUTURE LINES OF RESEARCH

The on-going committed research work will be strengthened, at both the headquarters and the regional stations at Bikaner, Jaisalmer, Pali and 12 Range Management Centres. Suitable fuel-cum-fodder-cum-fertilizer plants for desert areas will be identified and their adaptability tests conducted. Arid zone horticulture will get due emphasis by intensification of research in fruit trees like pomegranate, *Cordia myxa*, and *Capparis decidua*, and genetic improvement of crop plants like *guar* for gum and *til* for oil content will receive an additional thrust. With the help of the State Governments, rangeland management and demonstration centres will be established at suitable sites for increasing the productivity of rangelands.

CONTRIBUTIONS OF DIRECTORS

Arid zone research in India has completed 25 years, and to commemorate this an International Symposium, supported by the ICAR, DST and UNESCO, was organized in February 1978. A foreign visitor commented at the Symposium, 'CAZRI impressed me as one of the finest research institutes I have encountered'. To this unique status a number of distinguished directors have made their contributions, starting with Mr G. S. Lamba (1952-56), who was responsible for establishment of field stations and road-side plantations. The CAZRI has been fortunate to have the services of Dr P. C. Raheja (1960-66), who founded the Institute on sound scientific lines. He was also the Founder and Chief Editor of the *Annals of Arid Zone*, which is now in its 18th year of publication. Mr C. P. Bhimaya (1957-67) planned range management and afforestation programme of the Institute, which is being continued without major changes. Mr Bhimaya was associated with Mr C. S. Christian of the CSIRO (Australia), who visited in 1957 to prepare the project for the establishment of the CAZRI. Dr Mukhtar Singh (1968-69) and Dr T. R. Mehta (1969-70), though worked as Director for a brief period, made valuable contributions.

The present Director, Dr H. S. Mann, took over the charge of the CAZRI in December 1971. Under his leadership, the CAZRI has multiplied its facilities manifold. New research activities were initiated, including operational research projects entitled Arid Land Management, Arid Horticulture, Solar-Energy and Wind-Power Utilization, and Drip and Spinkler Irrigation. The CAZRI has attained international status

in arid-zone research and its services are in great demand. The CAZRI contributed significantly to the United Nations Conference on Desertification in 1977 and prepared a special Case Study as a background paper to this Conference. The Institute is associated with a number of international activities. There is considerable demand for training at the CAZRI of scientific and technical manpower from a number of countries in Asia and Africa.

## INDIAN GRASSLAND AND FODDER RESEARCH INSTITUTE, JHANSI (1962)

The Indian Grassland and Fodder Research Institute was established at Jhansi in November 1962 by the Government of India and administered from April 1966 by the Indian Council of Agricultural Research.

### Objectives

The Institute has the following research objectives: evolution of new technology for maximization of fodder production from intensively cultivated land; amelioration of forage production from marginal and submarginal lands which are agriculturally less productive; improving terrestrial and aquatic forage productivity based on improved production systems; development of silvipastoral systems and system synthesis for higher plant productivity for forage, fodder and fuel; studies on quality of forages and their efficiency in animal production; conservation and enrichment of cellulose wastes and crop residues as feedstuff; exploitation of forage production from waste-lands characterized as saline, alkaline and desert; exploitation of weeds, shrubs and conventionally non-edible plants for livestock nutrition and the extraction and use of their chemically active principles in livestock nutrition and forage-crop growth; analyses, syntheses and modelling of forage-crop-production systems by exploitation of resources, viz. sunlight, land and water, plant types, canopy manipulations to attain the possible biological yield targets; application of natural and farm energy for pre- and post-harvesting of forage and seed production and their conservation, development of mechanical devices for conservation of natural resources like water and soil; development and application of appropriate extension methods and techniques of transfer of technology for forage production systems to the rural farming community along with imparting training and education to the concerned developmental and research workers and farmers in the field of forage production and its efficient utilization.

The Institute was hitherto organized into eight partially multi-

discipline divisions and sections, viz. Plant Improvement, Soil Science and Agronomy, Grassland Management, Weed Ecology and Control, Plant Animal Relationship, Seed Technology, Agricultural Engineering and Extension and Economics. Extension and Economies has eight central sections, viz. Education, Cartography, Technical Information, Laboratory Services, Instrumentation, Photography and Art, Farm and Library. Administrative units are Administration, Audit and Accounts, Estate, Medical Unit and Hostel.

For conducting researches in the higher altitude, temperate, alpine and hilly regions extending from Jammu and Kashmir to Himachal Pradesh, Garhwal and Kumaon and north-eastern regions of the country, the Institute has established a regional station at Manasbal in the Jammu and Kashmir State with a nucleus staff.

Research centres of All-India Co-ordinated Project for Forage Crops, All-India Co-ordinated Project on Dryland Agriculture, and All-India Co-ordinated Project for Model Agronomy have been located at the Institute.

ACHIEVEMENTS

*Maximization of fodder production from cultivated lands.* The Institute has identified and extended research for maximization of fodder production for varied agro-climatic conditions of the country for intensive dairy farming. The packages of production of forages including relay cropping, year-round fodder production, insertion of fodder crops in rotations of food/cash crops were evolved with inter-disciplinary research components on new varieties, agronomic and soil-and water-management practices along with efficient utilization of fodders. Some tools operated manually or by bullock power were devised for production and utilization of forages from pasture and cropped lands.

This technology has shown, on experimental basis, a rise in fodder production to 1 000-2 500 q/ha/annum of green fodder with protein level of 6-7% compared with the hitherto level of 600 to 800 q/ha/annum.

*Exploitation of forage production from marginal and submarginal lands.* The country has about 25 % of the area under grazing and low-valued forest products including ravines, broken hills, marginal and submarginal lands which do not support agricultural crop production economically. During the Fifth Five-Year Plan researches were intensified in developing the concept of silvipastoral system on these lands. Its usefulness has been demonstrated at various places and there has been a general awakening of interest throughout the country in this field.

This theme provides for fuel and cattle feeding, particularly during the lean period when other green fodders are not available, and it also takes into account specific needs of sheep, goats and local cattle. Identification of species and forages suitable for different agro-climatic zones on such lands has been in progress. On experimental basis, amelioration of fodder production under dryland conditions from about 100 to 150 q to about 1 000 to 1 200 q/ annum of green fodder has been shown.

*Forage production component in dryland agriculture.* Evaluation of food-fodder systems under dryland agriculture was also initiated in the Fifth Five-Year Plan. Insertion of fooder crops in between the major crops and also intercropping of fodder crops with food/ cash, particularly leguminous ones, has shown an additional component of fodder production from such lands which also tend to ameliorate soil fertility.

*Animal-feeding values of herbages.* During the Fifth Five-Year Plan efforts were continued in understanding the livestock-feeding values of various fodder crops, silvipastoral plants and pastures. Progress was made in standardizing techniques of laboratory and animal sheds, and for assessing the nutritive and feeding values of fodder crops. Experiments were continued in determining the production levels of fodder crops. Experiments were also continued in determining the production levels of various livestock, largely fed on herbages, for providing feedback information to other forage-production technologies. Conservation techniques and amelioration of feeding values of straws and crop residues were continued for their improvement.

## TRAINING

A comprehensive training programme in all facets of grassland and fodder production and its efficient utilization, and for promoting herbage production for ruminant livestock was initiated.

The training programme of the Institute is categorized as : (*i*) a 9-month Diploma Course on Forage Production and its utilization, (*ii*) short-term refresher courses from 1 week to 3 months durations in the specific fields of Grassland and Fodder Production and its Utilization, and (*iii*) peripheral training for developmental workers and farmers.

A 9-month Diploma Course for in-service graduate candidates possessing degree in Agriculture, Animal Husbandry and Veterinary and related fields from State Departments of Agriculture, Animal Husbandry, Forestry, Dairy, Soil Conservation, Agro-Industrial Corporation etc. was initiated in 1976.

The Institute runs concurrently short-term training courses of 1 to 3 months duration for workers engaged in this field in the latest technology for silvipasture, cultivated fodders including control of forage insect pests and diseases, grassland management, seed production, forage conservation, forage-quality evaluation, range engineering and dryland forage production.

The Institute imparts practical field training to farmers and developmental workers such as field assistants, forest guards and village-level workers in specific field operations for cultivation of forage and seed production.

The Institute also provides facilities and guidance to the post-graduate research fellows for their Ph. D. degree in disciplines of forage and grassland production.

CHAPTER 24

# NATIONAL BUREAU OF PLANT GENETIC RESOURCES, NEW DELHI (1976)

THE National Bureau of Plant Genetic Resources was established at New Delhi in 1976 as a successor to the preceding organization operating since 1946 at the IARI, New Delhi, viz. Plant Introduction Division.

The Bureau functions as a nation-wide service organization for assisting all-India crop-improvement programmes at the central institutes and the agricultural and other universities in the country. It also participates as a member of global chain of plant genetic resources activities carried out by the International Board of Plant Genetic Resources, FAO, Rome.

## OBJECTIVES

The principal aims of NBPGR are :

1 To carry out and co-ordinate exploration and collection of plant genetic resources in India and abroad for use of plant breeders in India.

2 To carry out and co-ordinate exchange of plant genetic resources for use in plant breeding programmes in India and in other countries.

3 To attend to plant quarantine inspection, treatment and curing of plant genetic resources exchanged through it.

4 To maintain and co-ordinate maintenance of 'base' collections of genetic resources of specific crops in the form of seed.

5 To maintain and co-ordinate maintenance of national 'active' collections of seeds of genetic resources of crops in India.

6 To maintain and co-ordinate maintenance of genetic resources of economic plants in the form of propagating material other than seed, e.g. annual or perennial plantings in genetic gardens, storage of different kinds of vegetative propagules, cell structure and their deep-freeze storage etc.

7 To set up natural gene sanctuaries of plants whose resources are endangered.

8 To carry out and co-ordinate research on improvement of certain industrial plants like medicinal and aromatic plants.

9 Characterize germplasm collections in selected crop plants grown under diverse agro-climatic conditions at its headquarters and regional stations.

10 To prepare inventories and catalogues of such plant genetic resources for use of plant breeders in India.

### Early Plant-Introduction Work

The beginning of a centralized plant introduction service at the IARI was represented by a scheme initiated in the Division of Botany in 1946 at the instance of the ICAR. It was replaced by the Plant Introduction and Exploration Organization under the same Division in 1956 in the Second Five-Year Plan. A new Division of Plant Introduction was set up in 1961 during the Third Plan. Though the nature of work of this service has remained the same all along, it has been progressively expanded and consolidated.

The most prominent functions were : (*i*) seed exchange, i.e. procurement of plant material of agri-horticultural interest, including prospective breeder's stocks of the *cultigen species, their land races and* wild-relatives from foreign countries mainly through correspondence, under phyto-sanitary conditions for use by the Central and State institutions for experimental purposes; (*ii*) exploration, inland and abroad, for collecting plants of this category; (*iii*) maintenance, multiplication, evaluation and utilization of collection on its farms at different locations or co-ordinating this type of work under the auspices of other institutions to whom the material is transmitted; and (*iv*) supply, also under quarantine control, of similar material to foreign indentors.

The organization was supported at that time by three substations located in different agro-climatic zones, viz. at Simla (at an altitude of *ca* 2 300 m in the Himalayas), at Amravati on the Deccan plateau, and at Jodhpur in the semi-arid region of Rajasthan. Quarantine control over the material exchanged through this service was exercised by the units of the *Directorate of Plant Protection, Quarantine and Storage* at all concerned sea- and air-ports and other points of entry through overland routes. At Delhi, in addition, the units set up in the Division of Mycology and Plant Pathology and the Division of Entomology of the IARI assisted in similar work, relating to both incoming and outgoing material. Moreover, these units also kept a constant surveillance over the live plant collections under maintenance on the farms of the Institute. This checked the concomitant entry of pests and diseases with new plants which may lead to mass destruction of even the existing plants.

### Explorations

The following are the important schemes undertaken by the NBPGR.

*Scheme on legumes and grasses*. Under this scheme hill areas in Uttar Pradesh and Western Ghats were surveyed and germplasm of wild legumes and grasses, and of the cultivated types, was collected for their utility as food, forage and conservation . Variable germplasm was assembled for cowpea, greengram, blackgram, *Cajanus*, horsegram, soybean, Frenchbean, pea, lentil and pearlmillet. Wild germplasm included over 500 samples of herbage legumes (*Crotalaria*, *Alysicarpus*, *Atylosia*, *Vigna*, *Teramnus*, *Clitoria*, *Demodium*) and over 1000 in grasses (*Cenchrus*, *Pennisetum*, *Dichanthium*, *Dactylis*, *Phleum* and others).

*Exploration in north-eastern hills*. Since 1970 collections of local land races and primitive types, and wild relatives of crop plants particularly from tribal-dominated tracts—were made. Explorations were undertaken in Meghalaya, Manipur, Mizoram, Tripura, Arunachal Pradesh and Assam. Over 4 500 collections were added to the existing variability. These collections include pop maize with primitive traits and much variability in cob size and grain colour. Besides, sugary forms were collected. In rice collections glutinous and non-glutinous, scented, glabrous, awned-unawned, white, red and brown kernel types with tall and dwarf forms were included. Coarse-grained types with some primitive cultures with roundish millet-like grain were also collected. Among millets, much variability of tall semi-dwarf forms was observed in *Setaria* in inflorescence size or colour. Local millets included soft-shelled forms in *Coix lacry-jmaobi* and the minor-millet *Digitaria cruciata* var. *esculenta*, cold-tolerant local cultigen used by Khasis for food and fodder. In grain legumes, germplasm collected was mainly of soybean, cowpea, Frenchbean, blackgram, winged bean and ricebean. Much variability existed in ricebean in grains/pod and colour variation of seed, and a rich collection was made. The Bureau has the richest variability in this crop now in South Asia in general and in India in particular. Other germplasms collected include sesame, brassica, cucurbits, okra, chillies, and other non-tuberiferous solanums and some collections of taros and yams.

Apart from builaing up germplasm variability, these exploration surveys also led to clues on the domestication of some of the indigenous food crops like the tuber legume, *Moghania vestita*, and the millet, *Digitaria*, both domesticated by the Khasi tribals. Through these explorations the Bureau has been able to build up its rich collection in ricebean and soft-shelled *Coix* forms.

*Explorations in peninsular tribal belt*. Surveys conducted in south Bihar and Orissa, and in Agency areas of Andhra Pradesh, found much

variability, particularly in millets like *Sorghum* and *Panicum miliare*, legumes like greengram and *Cajanus*, and local type *Mucuna*. Germplasm also represented good variability in rice, maize, niger, sesame, brassica, chilli, cucurbits, brinjal and kenaf. Primitive mottled, blackish-grained types were also collected in greengram .

*Cold arid tract*. Areas of Lahaul and Spiti were surveyed and local types in wheat, barley, amara-th and buckwheat and other crops were collected. Tall types, awned or awnless, variable in spikelets, grain size or colour occurred in wheat, and likewise much variation was represented by naked barley varieties. Some collections of high-altitude maize and rice in the valley zones (13 000 m) were also made. Collections also included less-known medicinal plant *Inula* sp. (*mano*), considered superior to *Saussurea lappa* (*kuth*) in its oil content.

*Collection of local wheat germplasm from Rajasthan, Gujarat and Madhya Pradesh*. Explorations were undertaken in this scheme in tribal-dominated, rainfed areas of Madhya Pradesh, Rajasthan and Gujarat. Over 1 500 collections were made in *Triticum aestivum*, *T. durum*, and *T. dicoccum*. *T. durum* types presented more variability, and several bold-grained types of dark amber or light amber-coloured grains, tall to semi-dwarf in habit were collected. In soft wheat also similar variation in grain colour, with good morphological diversity in spikes or awns etc. was observed. *T. dicoccum* was collected from this belt. The collections represented genotypes adaptable to rainfed, semi-arid habitats, saline soils and possibly drought. Besides, germplasms of hooded barley, pearlmillet, *Sorghum*, *Setaria* and *Echinochloa*; of legumes like greengram, blackgram, mothbean, gram, *Cajanus*, clusterbean (*guar*) and *Dolichos*, and of sesame, brassica, cucurbits were made.

*Germplasm collection of jute and cotton from N-E region*. The NBPGR organized an exploration for collection of jute and cotton germplasm from the North-East Region in collaboration with corresponding crop-based institutes. Over 450 accessions were collected from 44 tribal sites. Some of the *Gossypium arboreum* (*cernuum*) types were prolific bearers, exhibiting variation in plant height (40-100 cm). In jute, much variation was also collected both in *Corchorus olitorius* and *C. capsularis*. Many of these forms including semi-wild types, were from rainfed sites. Other variability available in such locations was in rice, maize and millets like *Setaria* and tall forms in *Sorghum*, legumes like ricebean, Frenchbean, oilseeds like brassica, sesame, non-tuberiferous solanums, and cucurbits.

*Collections made in Indonesia*. During July-August 1977, opportunity

was availed of to collect germplasm variability in winged bean (presenting bold and small grain types), long or short podded types (15-30 cm), green colour to creamish, whitish, buff, reddish, brown, black; bold-grained greengram and bushy ricebean were collected.

*Exploration for germplasm of nut-crops.* Under Indo-USSR protocol, exploration was undertaken in the central Asian republics of the USSR for collection of the germplasm of nut crops during September-October 1978. Information on varieties and perspective forms available was collected and over 190 collections were made, which showed variability in cultivated and wild forms of pistachio, walnut and almond, and other agri-horticultural kinds, particularly cold-adaptable varieties, and some wild types. A good collection of germplasm of wild *Amygdalus* species, viz. *A. spinosissima, A. ledebomiano, A. bucharica, A. nana, A. communis* var. *amara, A. patunikowis* and *A. kalmikovii*, presented hardy forms tolerant to extreme cold and drought.

## Exchange of Germplasm

Through plant-exchange activities the Bureau has been able to procure material of various agri-horticultural crops from 50 countries and seed materials were made available to scientists in 76 countries.

*Plant quarantine.* The entry and establishment of new diseases and pests with imported plant material has been proved to be hazardous to the agricultural and horticultural economy of the importing country. Therefore all the introduced materials from abroad are subjected to vigorous quarantine screening for accompanying pests and diseases. Over 75 200 samples per year were examined, treated if necessary, and cleared or rejected. Hot-water treatment of *Phoma*-infected seed of sugarbeet was developed to get rid of its infection. Study of published information on global incidence of pests and diseases of important plants is in progress.

*Nematology.* To prevent introduction of nematodes through experimental planting material, examination of imported plant materials from various countries of the world was taken up at the IARI in the Division of Nematology, in June 1968. This quarantine section (Nematology) became a part of the NBPGR on 1 August 1976.

From June 1968 to December 1978, a total of 576 100 seed and plant samples belonging to a number of agricultural, horticultural and medicinal plants were examined for association with or without infestation with nematodes. Of these, 18 783 samples of various types of plant materials were found to be infested. Approximately 17 86 samples

were salvaged by using various denematization techniques and cleaning procedures. About 889 samples were rejected and destroyed.

*Maintenance of collections.* Genetic resources of several agri-horticultural crops are maintained by the Bureau at its headquarters and regional stations by periodic regeneration, the frequency of which varies according to the nature of the crop. The Bureau at its headquarters maintains a collection of over 16 757 accessions, including those of grain legumes.

Five regional stations located in different agro-climatic regions also maintain working collections.

The Bureau now maintains a rich collection, particularly of *amaranth* and Frenchbean at Simla; of *guar*, cowpea, *moong*, *urd*, pea, ricebean and winged bean at Delhi, and of soybean and *Dolichos* at Amravati.

*Evaluation of collections.* In grain legumes more than 6 000 germplasm collections in grain legumes such as *moong* (1 300), *urd* (1 200), cowpea (900), ricebean (500), pea (1300), lentil (300), grasspea (*khesari*) (250), *Trigonella* (190), gram (250), *Crotalaria*, *Sesbania* (190) and wild legumes (250) are being maintained and have simultaneously been evaluated for various yield-contributing characters, quality characters, and reaction to fungal, viral and bacterial diseases. Useful genotypes having desirable attributes such as earliness, long pods, more number of seeds/pod, seed size, pods/plant, resistance to diseases and quality characters have been identified in pea, *moong, urd* and cowpea. Wild related species of *Vigna* and *Cajanus* have been collected and conserved for use in crop improvement. Wild legumes useful for food, fodder and soil conservation or for green-manure have also been identified.

In oat about 900 collections (mainly exotics and cultivated types) introduced from Australia, Canada, the UK, the USA, the USSR, West Germany, France and Scandinavian countries are maintained. Some promising types identified as fodder, grain and dual purpose are given below.

'Algerian' and *Acacia* (from Australia) are suitable for late sowing for supply of green fodder in early summer months in India. 'Flaming Gold' (from Germany) is another excellent fodder type. 'NP 101' (introduced as a line from Australia) and 'Rapida' (from the USA) are excellent grain types and are fairly high in protein content (117-8%). 'Rapida' is the earliest in our collection; it matures in 120 days.

'Kent' (from Australia) is still popular as dual-purpose variety. The lines 'E C 102649', 'EC 102650' and 'EC 102651' (from Australia) were identified as promising ones and are in the multiplication stage.

*Cataloguing.* Two catalogues of field-pea giving information on about 700 accessions for 15 characters have been published. Active collections have been characterized and catalogues for cowpea, *moong*, *urd*, Frenchbean, *guar* and soybean are under preparation in collaboration with the Genetic Resources Information System at Boulder, Colorado, the USA, and the IASRI, New Delhi. Bulletins on ricebean and winged bean are being prepared.

*National Germplasm Repository.* For any genetic resources centre, a cold-storage laboratory for long-term conservation of germplasm is a must for avoiding frequent regeneration to keep the seeds viable. A facility for storage of germplasm of important economic crops in the form of seed for several decades under —20°C temperature is to be created shortly.

*Gene sanctuary.* It is also envisaged to preserve pockets of natural plant wealth *in situ* as gene sanctuaries. Such areas exist particularly in north-eastern region where immense diversity of *Musa*, *Citrus*, *Oryza*, *Saccharum* and *Mangifera* and their wild relatives exist. Proposals for the establishment of *Citrus* gene sanctuary in Meghalaya are in the final stage.

Computer facilities available at the IASRI will be utilized for computerizing all data and genetic-resources activities like inventory, evaluation and storage. This facility will also help in the retrieval of information on germplasm.

## CENTRAL PLANTATION CROPS RESEARCH INSTITUTE, KASARAGOD (1970)

The Central Plantation Crops Research Institute, Kasaragod, came into existence in 1970, with the amalgamation of Central Coconut Research Stations at Kasaragod and Kayangulam and the Central Arecanut Research Station, Vittal, and its regional stations. The Institute has its headquarters at Kasaragod. It has five regional stations, viz. Vittal, Calicut, Kayangulam, Lakshadweep and Goa. The research centres of the Institute are located at Appangala, Hirehalli (Karnataka), Palode, Peechi (Kerala), Mohitnagar (West Bengal), Kahikuchi (Assam) and Sipighat (Andaman Islands). There are two elite seed farms at Kidu (Karnataka) for producing genetically superior planting material of coconut, arecanut and cacao, and at Shantigodu (Karnataka) for evaluation and multiplication of high-yielding cashew.

The Institute conducts research on coconut, arecanut, cashew, cacao, oil-palm, pepper, cardamom, ginger, turmeric and tree spices. It

is also the main centre for the All-India Co-ordinated Crop Improvement Project on coconut, arecanut, spices and cashewnut. The Coconut and Arecanut Improvement Project has 12 participating centres, and the Spices and Cashewnut Improvement Project has 16 participating centres located in agricultural universities. The Institute imparts training to the staff of the Farmers' Training Centres, and research workers including those deputed from foreign countries by international agencies like the FAO and the UNDP. One hundred and thirty major research projects pertaining to problems of plantation crops are manned by the scientists of the Institute.

The Institute has two Operational Research Projects which aim at all-round improvement of the village, with emphasis on gardenland management at Muttathody near Kasaragod, and another on improvement of diseased coconut palms at Krishnapuram in Kerala.

CHAPTER 25

# RECENTLY ESTABLISHED CENTRAL RESEARCH INSTITUTES

## VIVEKANANDA PARVATIYA KRISHI ANUSANDHAN SHALA, ALMORA (1974)

THE Vivekananda Laboratory, now known as 'Vivekananda Parvatiya Krishi Anusandhan Shala' (Vivekananda Laboratory for Hill Agriculture), came into existence on 4 July 1924, when its founder, the late Professor Boshi Sen, after having worked for 12 years with Sir J. C. Bose, the renowned Plant Physiologist, decided to establish his own laboratory. Inspired by the ideals of Swami Vivekananda to serve the hungry and the downtrodden, Mr Boshi Sen took the greatest decision to start a laboratory of his own. He felt that India was far behind the West in scientific development, and if she was ever to catch up in the world of modern science a few big institutions located in cities would never be able to create scientific awareness among the people. In his opinion a large number of centres of research scattered all over the country and manned by dedicated workers were needed. In 1936 Mr Boshi Sen decided to shift the Laboratory permanently to Almora in Kumaon Himmalayas, where he settled down with his wife, Mrs Marguerite Emerson Sen, a well-known writer. He named the laboratory after his guru, the great Vivekananda.

Research was first started on the living plant cells. Just as such cells form the tissues which in turn form the whole plant, the Laboratory has grown into a pioneering research institution, not only concerned with plant physiology but with practically all aspects of crop-plant research. The Laboratory, which was started in a kitchen of a house in Calcutta more than 50 years back, can now boast of being a well-equipped institution capable of working on plant physiology, genetics, pathology and chemistry with good library facilities and buildings to house the working units. It has also a farm of more than 80.94 ha attached to it at Hawalbagh, 13 km from Almora, and has a team of qualified scientists. The Laboratory was transferred by the Uttar Pradesh Government to the ICAR in October 1974. Facilities in the form of field laboratories, better equipment and greater number of scientists in different disciplines of agricultural research are being added by the ICAR.

The Laboratory, to start with, concentrated on fundamental aspects

of plant physiology but the Bengal famine of 1943 made a profound impression on the mind of Mr Boshi Sen and he turned his attention to the development of hill agriculture. By that time Mr Sen's work had begun to attract the notice of the Government of Uttar Pradesh and the ICAR. Subsequently, the Uttar Pradesh State Government and the ICAR began to finance special schemes. A piece of land measuring about 0.4 ha was placed at its disposal in early forties and the first laborratory building at its Almora site was built in 1943.

In 1952 the Laboratory was first allotted about 6.07 ha of land at Hawalbagh, where applied research on almost all food and fodder crops grown in the Kumaon hills was started. In 1959, to ensure continuation of the work, the Laboratory was transferred to the Department of Agriculture of the Uttar Pradesh Government. Realizing its importance as the only agricultural research institution in the hills of Uttar Pradesh, the Government of Uttar Pradesh in 1968 transferred more than 80.94 ha of land at Hawalbagh from the Directorate of Fruit Utilization to it. The work initiated by Mr Boshi Sen continued to grow till his demise in August 1971.

## ICAR RESEARCH COMPLEX FOR NORTH-EASTERN HILLS REGION, SHILLONG (1975)

The ICAR Research Complex for North-Eastern Hills Region was formally inaugurated by the Union Minister for Agriculture and Irrigation, Mr Jagjivan Ram, at Kohima, Nagaland, on 22 November 1975.

The Complex was established on the recommendation of a seminar on the 'Research and Training Needs in Agriculture and Animal Husbandry of the North-Eastern Himalayan Region' organized by the ICAR at Shillong on 23-26 October 1973. In the plenary session of this seminar held under the chairmanship of Dr M. S. Swaminathan, it was recommended that an ICAR unit should be established at Shillong to work on the research and development needs of the north-eastern part of the country, viz. Meghalaya, Tripura, Manipur, Arunachal Pradesh, Nagaland, Mizoram and the North Cachar and Mikir Hills of Assam.

A research institute under the ICAR was established in January 1975. This institute took up research in all important disciplines of agriculture, animal sciences and fisheries, and was named 'ICAR Research Complex for North-Eastern Hills Region'. Its headquarters along with a research station was located at Shillong, Meghalaya. Simultaneously, research centres in Nagaland, Manipur, Tripura, Arunachal Pradesh, Mizoram, Assam, Andaman and Nicobar Islands, Goa and La-

kshadweep started functioning. The research centre in Assam was located in Karbi Anglong under the administrative control of the Assam Agricultural University. Similarly, Goa and Lakshadweep centres were under the administrative control of the Central Plantation Crops Research Institute, Kasaragod.

In 1976 an ICAR team was sent to Sikkim to assess the need for research in agriculture and animal sciences. On the recommendation of the team, a research centre was established in Sikkim in 1976 and located in Gangtok. The locations and altitudes of the research stations are given below.

| State/Union Territory | Location of research centre | Altitude (in m, above mean sea level) |
|---|---|---|
| Meghalaya | Upper Shillong | 1 829 |
| | Barapani | 1 128 |
| Nagaland | Yiesimyong | 1 087 |
| | Medziphema (Ghaspani) | 450 |
| Manipur | Imphal | 853 |
| Tripura | Lembucherra | 122 |
| Arunachal Pradesh | Basar | 762 |
| Mizoram | Kolasib | 762 |
| Sikkim | Gangtok | 1 524 |

The Institute started functioning with the following objectives: (*i*) to provide an adequate base for research; (*ii*) to provide an alternative farming system to replace *jhuming* and to improve its productivity; (*iii*) to develop each area according to its potentialities through research in food crops, fruits, other economic crops and animals including poultry; (*iv*) to raise the level of local competence in scientific manpower; and (*v*) collection of indigenous cultivated and wild germplasm in crops and animals and their utilization for improvement and preservation.

## CENTRAL INSTITUTE OF AGRICULTURAL ENGINEERING, BHOPAL (1976)

The Central Institute of Agricultural Engineering, Bhopal, came into existence on 15 February 1976. The idea of setting up a National Institute of Agricultural Engineering in India was conceived with the aim of applying agricultural engineering knowledge to planned development of agriculture. Since Independence there has been rapid advancement in the technology of modern industrial engineering, resulting in increased industrial production and improvement of urban life. This

has caused serious imbalance in the economy, as the disparity between rural and urban areas has further increased, resulting in massive migration of rural agricultural labourers to cities.

About 70% of the India's cropped area being unirrigated, the productivity of such a land is low, especially in the absence of proper tools and implements, so that farm operations are carried on timely and the available soil moisture is effectively utilized. Likewise, in irrigated areas also, due to lack of proper implements, the farm operations are seldom done timely and efficiently. This results in lower yields. Lack of proper methods and equipment for processing, handling and storage of foodgrains also results in loss of about 10%.

Besides, the introduction of high-yielding varieties and increased intensity of cropping require intensive and time-bound farm operations for sustained yields. The adoption of modern agricultural technology also requires use of efficient tools, implements and machinery. An analysis of high agricultural production in the States of Punjab and Haryana compared with other States of the country indicates vital contribution made by improved farm tools and machinery. The need of National Institute of Agricultural Engineering was felt primarily to develop improved implements, machinery and technology for crop production and post-harvest operations, storage, and to work on different sources of energy on the farm. The Institute will forge a ling between the government, manufacturers and the farmers. It will provide training facilities to village artisans, engineers, technicians and agricultural officers. It would guide the manufacturers in quality production of agricultural implements at a reasonable cost. It will work as a fountain-head for research on agricultural engineering.

A proposal to convert the Agricultural Engineering Division at the IARI, New Delhi, into a National Institute of Agricultural Engineering on a modest scale was made by the Achievement Audit Committee in 1963. From time to time the Indian Society of Agricultural Engineers also pressed the Government for such an institute. The Planning Commission, the National Committee for Science and Technology, and the Working Group for Agricultural Research, Manpower and Education accepted the need for such an institute. Consequently the ICAR formulated a project for the establishment of a National Institute of Agricultural Engineering during the Fifth Five-Year Plan period. The name of the proposed Institute was later changed from National Institute of Agricultural Engineering to the Central Institute of Agricultural Engineering.

The Central Institute of Agricultural Engineering (CIAE) was formally started at Nabi Bagh, Berasia Road, Bhopal, Madhya Pradesh, with effect from 15 February 1976. Mr T. H. Nirmal, the then Project Co-ordinator, Post-Harvest Technology Scheme at the IARI, New Delhi, assumed the charge of Officer-in-Charge. The headquarters of the Post-Harvest Technology Scheme was also transferred from the IARI, New Delhi, to the CIAE, Bhopal. Prof. A. C. Pandya assumed charge as the first Director on 2 May 1977. The headquarters of the scheme on 'Research and development of farm implements and machinery and production of prototypes and their evaluation under different agro-climatic conditions' was also transferred from the IARI, New Delhi, to the CIAE, Bhopal, in September 1977.

The Institute took about 2 years to overcome the initial teething troubles, e.g. getting land from the State Government, and organizing infrastructure. It started work in a rented building with the barest minimum facilities by way of research, technical and supporting staff, equipment, research workshop and laboratories. The Institute launched a programme of research, testing and field evaluation, co-ordination of research documentation of agricultural engineering, research information and preparation of technical bulletins and monographs. Operational research projects and assistance to other ICAR research organizations was also taken up. Technical guidance to farmers and manufacturers, farm development and planning was also taken up. It also arranged special meetings to work out action programmes on some of the important national problems of agricultural machinery like enforcement of safety measures on threshers to avoid accidents.

Some of the research projects on development of *kharif* technology for black soils, implements for hill areas, cheap and efficient driers for crops and vegetables, cheap storage bins and structures for storage of foodgrains, low-cost farm houses and structures, efficient biogas plants, use of solar energy for heating and other purposes have also been initiated.

## CENTRAL AGRICULTURAL RESEARCH INSTITUTE FOR ANDAMAN AND NICOBAR GROUP OF ISLANDS, PORT BLAIR (1978)

The Central Agricultural Research Institute for Andaman and Nicobar Group of Islands was established in June 1978 for providing the research base for developing agri-horticulture, livestock and fisheries.

The Director joined his post in June 1978. The Institute is under

establishment in a 40.47-ha piece of land covered with dense mixed forest on a hilly terrain. The forest has since been partially cleared. It is proposed to locate the Institute's research wings and offices etc. during the first phase of its operation on agri-horticultural, animal and fisheries sciences research. The regional research centres of the IVRI, CMFRI, and IARI have been amalgamated with the Institute.

About 2.02 ha of farm land was given to the Institute for its use by the Andaman and Nicobar Administration for field experiments at Bloomsdale, about 22 km away from Port Blair. Experiments in crop and soil sciences have already been laid out.

AGRICULTURE

*Field crops.* The CARI (ANGI) till the last *kharif* season has experimented on 40 hybrids of rice to blast resistance. New crops have been successfully tried such as *ramie*, *Pennisetum pedicellatum*, *Stylosanthes humilis*, *S. gracilis*, *Glycine javancia*, *jowar*, siratro, *Desmodium*, winged bean, improved lines of vegetables from the IIHR, Bangalore; rice; bean, sunflower, sorghum, pigeonpea, tree fodders like *Leucaena*, *Sesbania* (*agathi*) etc. Programme on red oilpalm, cloves, nutmeg, intercultural crops etc. are being developed. Potato is currently imported from the mainland. With the collaboration of the CPRI, Simla, experimental cultivation of potato has been attempted among farmers in various potential areas in the Diglipur (north Andamans) and south Andamans regions. Benchmark survey among farmers has been conducted and improved varieties of seeds have been tried at farmers' fields. With the collaboration of the IARI, biogas plants have been arranged to be installed and demonstrated among farmers. Energy shortage is an acute problem in the entire group of islands. The ubiquitously available cowdung and leaf-litter are proposed to be utilized for generation of biogas. Similarly, experiments are underway for cultivation of mushrooms and bee-keeping.

*Control of giant African snail.* The CARI scientists have developed some practical measures for the control of the giant African snail with 5% metaldehyde, for which no phyto-toxicity has been observed. Experiments are under way for biological control of the snail, which have become a menace to the Island's economy. These snails were introduced by the Japanese during their occupation of the Islands during the Second World War.

*Pest and disease control.* Surveys have been conducted on the prevalence of pest and disease problems of crops which greatly affect

the yield, and their remedial measures specific for the Islands are being worked out.

ANIMAL SCIENCES

Filarial dermatitis, which is extensive in the Islands and causes loss to cattle and buffaloes, has for the first time been controlled with the application of indigenously available organophosphorous filaricides.

CHAPTER 26

# INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE, NEW DELHI

## From Statistical Branch to Institute (1933-59)

THE Indian Agricultural Statistics Research Institute conducts research and training in agricultural statistics for improving the planning and evaluation of agricultural research and development in the country. The main functions of the institute are : (*i*) to conduct research in experimental designs, sampling methods, statistical genetics and computer programming and data processing; (*ii*) to conduct postgraduate courses for training professional statisticians and in-service training for agricultural scientists ; (*iii*) to provide advisory service to agricultural scientists and agricultural organizations; and (*iv*) to provide consultancy service for data processing.

The Institute has played an important role in the application of statistical methods to agricultural research in India and has achieved international recognition for the high quality of its research work and training. A number of research workers from the Institute have served as consultants and advisors in the Asian, African and Latin American countries. Also, a number of statisticians and trainees of the Institute are at present occupying high positions in the universities and other research institutions of the USA, Canada and other countries.

The Institute made a modest beginning in 1933 as a statistical section of the then Imperial Council of Agricultural Research on the recommendations of the Royal Commission of Agriculture. It was kept under the charge of a Statistician with limited objectives. The activities of the statistical section increased rapidly with the appointment of Dr P. V. Sukhatme as Statistician to the Council in 1940. The important fundamental development was the institution of research in the theory of statistics, since appropriate methods were not always available ready-made for solving practical problems arising during the course of the collection of data. The extension in the scope and activities of the section was accompanied by an increase in staff from time to time.

The activities of the Statistical Section entered a new phase towards the end of 1943 when, following the Bengal famine, the Government of India directed it to undertake research in the methods of

Fig. 27. Central Plantation Crops Research Institute, Kasaragod — sprinkler irrigation

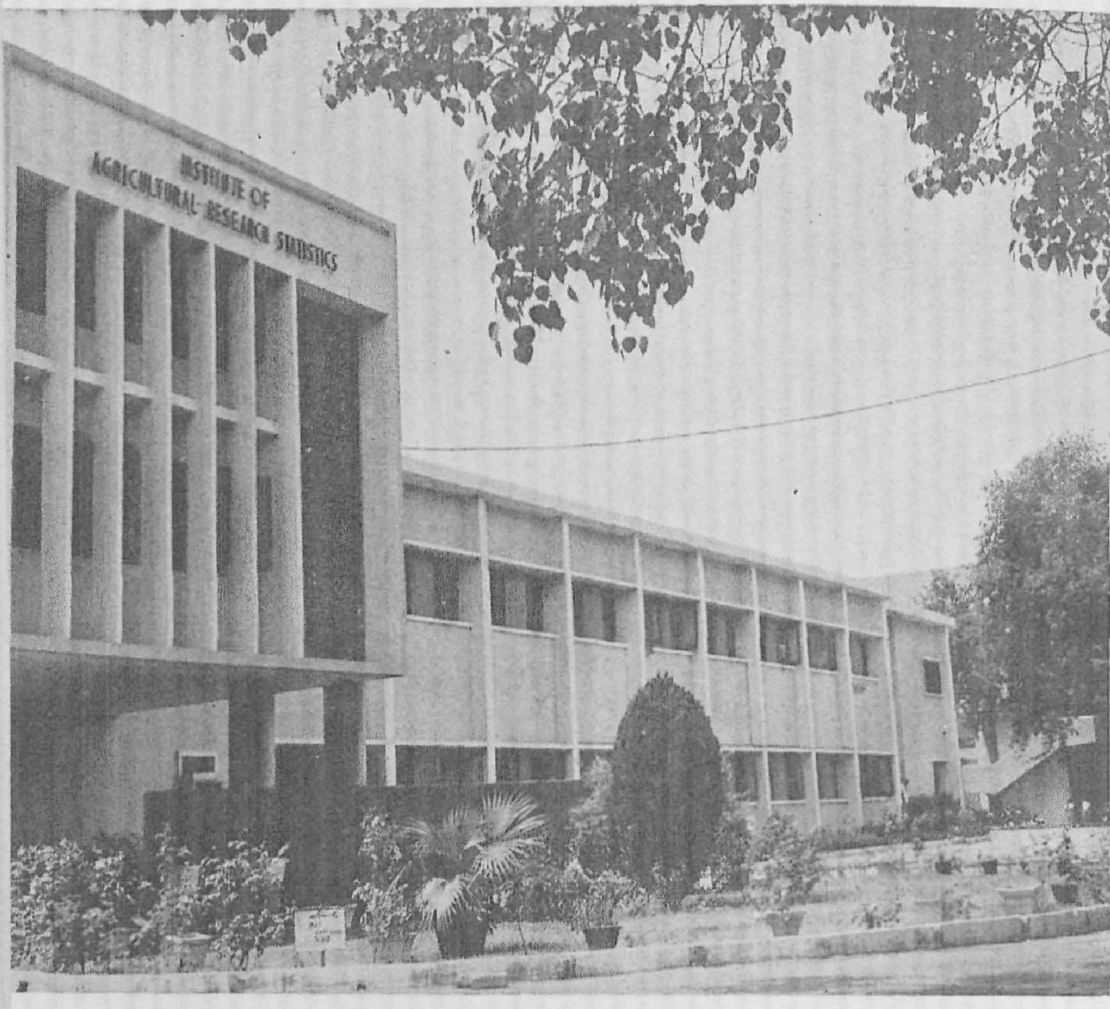



Fig. 28. Indian Agricultural Statistics Research Institute — the old building

collecting yield statistics of crops by conducting objective surveys based on the method of random sampling. In the course of this work, the statistical section had to undertake research in sampling theory and train statisticians and field staff running into several thousands. The work involved in the scrutiny, compilation and analysis of the resulting mass of data was immense and this resulted in the reorganization of the Statistical Section. The Section was then turned into branch in 1945 and the designation of the Statistician was upgraded to Statistical Advisor. The advisory work relating to agriculture and animal husbandry was split into two separate units, each under the charge of a Statistician. In 1945 the Council instituted regular courses of instruction to train professional statisticians. Two postgraduate training courses in statistics, the Certificate Course and Diploma Course, were started for this purpose. With the growing popularity of training courses and the increasing demand for admission, a Training Unit was established in 1948 with a teaching staff consisting of two Professors, one Assistant Professor and two Research Investigators.

The period between 1945 and 1949 was one of intense activity in the statistical branch, when under its technical guidance and with the financial assistance provided by the Government, yield surveys by the random sampling methods carried out in almost all the major States on both wheat and rice crops. By 1949 the results of these sample surveys were being used for formulating official forecasts, and gradually these surveys were extended successfully to other crops such as *jowar*, gram and other pulses. One Assistant Statistical Adviser, two Statisticians, four Regional Officers and two Investigators were appointed on the Statistical Branch to implement the scheme of crop-cutting surveys.

The Statistical Branch of the Council received international recognition when under the joint auspices of the ICAR, FAO, the Statistical Office of the United Nations and ECAFE an International Training Centre on Censuses and Statistics for South-East Asia was held at New Delhi for 14 weeks, commencing from 1 November 1949. The main purpose of the training centre was to help member governments in developing their census and sampling techniques as applied to population and agriculture and to disseminate information on international recommendations regarding the world agricultural and population censuses to be held in 1951. In addition to delegates from various States of India, over 35 delegates from Burma, Pakistan, Nepal, Indonesia, Ceylon, Indo-China, Korea and Thailand participated.

The period between 1951 and 1955 was again marked by further intense and useful activity on the part of this Statistical Branch, the use of the sample survey techniques was successfully demonstrated in assessing correctly the results of the Grow More Food campaign of the Government of India, which was started around 1947. Fisheries and livestock surveys were also started during the period, whereas cost of production surveys relating to crops as well as milk were initiated. By the end of 1952 the extension of the work under the co-ordinated scheme of crop-cutting surveys on principal food crops to the whole of the country was practically complete. In January 1953, according to the decision of the Government of India, the work relating to the 5 years' co-ordinated scheme of crop-cutting surveys on food crops, the sample surveys on area statistics, the Grow More Food Assessment Surveys and the agricultural census was also transferred from the ICAR to the National Sample Survey Organization. The services of the staff working under these schemes were also transferred to the NSSO. An important event during this period was the assumption of office as Statistical Adviser to the Council by Dr V. G. Panse on 16 August 1951. Dr P. V. Sukhatme, the previous incumbent, left the Council to take up the post of Chief, Statistics Branch, FAO, Rome, and subsequently the Director of Statistics Division of that organization. Dr Panse, formerly Director of the Institute of Plant Industry, Indore, had been associated closely with the work of the Statistical Branch of the Council in the development of sampling techniques for agricultural surveys and other problems for several years. In September 1952 the services of two FAO experts, Dr D. J. Finney of the Oxford University, England, and Dr Frank Yates of the Rothamsted Experimental Station, Harpenden, England, were assigned to the Government of India to advise and assist the ICAR in reviewing its research and training activities. In their report submitted in March 1953, they examined the research and training activities of the statistical branch, noted its handicaps and recommended some new activities that may be taken up usefully in the immediate future. They also recommended an increase in the staff to handle effectively the new lines of statistical research suggested by them and setting up of a separate home for the Statistical Branch at Pusa in the neighbourhood of IARI for closer collaboration with the Institute. These were promptly implemented. An important project, which is still continuing, was the setting up of a National Index of Field Experiments.

The Statistical Branch received further international recognition,

when during the later part of 1954 it organized a 3-month International Training Centre of Experimental designs and Survey Techniques jointly with the Food and Agriculture Organisation of the United Nations. The main object of the Centre was to develop the skill of the workers engaged in experimental research in agriculture and animal husbandry and train new personnel from countries in the Middle East, the South-East Asia and the Far East. Thirty-six trainees from 12 different countries participated in the Centre.

In August 1955 the Statistical Branch moved into its new building situated at Pusa and became the Statistical Wing of the Council. The building provided adequate space for library, reading rooms, lecture halls, an auditorium and a playground, besides office space for its technical and ministerial staff. A hostel with all the modern amenities was also provided for the trainees. About the same time, posts of one Deputy Statistical Adviser, one Senior Research Statistician, two Statisticians, one Assistant Statistician and 20 Technical Assistants and other administrative staff were also sanctioned to meet the increasing tempo of research and expanding needs of statistical training at various levels.

An international seminar on the 'Policies to support and stabilize agricultural prices and income in Asia and the Far East', sponsored jointly by the FAO, ECAFE, and the Government of India, was organized by the Statistical Wing in March 1958, at New Delhi, in which the workers of the Wing took an active part and contributed on the methodology of collection of cost and other data. In February 1959 the Statistical Wing was responsible for holding an International Training Centre on Fisheries Statistics jointly set up by the FAO and the Government of India for the benefit of South-East Asian countries, in which senior members of the staff delivered lectures on sampling, statistical methods and their application to fisheries statistics.

In recognition of its scientific functions of research and training, this Wing of the Council was redesignated by the Government of India as the Institute of Agricultural Research Statistics, in June 1959, thus implementing an important recommendation made by the FAO experts Dr Finney and Dr Yates in their report mentioned earlier. A Mechanical Data Processing Unit was also added to the Institute around this time.

An important landmark in the development of the Institute was the installation of an electronic computer, IBM-1620-Model II, in 1964, in the newly constructed four-storey building of the institute. With the increased tempo of work during the Third Five-Year Plan period, the

Institute was finding it difficult to cope up with its increased activities. With the installation of the computer all its activities could also be streamlined after clearing all back-log. The construction work of a new building in the campus of the Institute to serve as Computer Laboratory and Library was taken up by the Central Public Works Department in June 1973. The building was completed in 1975.

In view of the increased demand for trained statisticians in the field of agriculture and animal husbandry, the Institute in collaboration with the IARI started in October 1964 new courses leading to M. Sc. and Ph. D. degrees in Agricultural Statistics.

Consequent to the reorganization of the ICAR, the IARS was declared a full-fledged institute and as one of the institutes of the ICAR with effect from 1 April 1970. It was now headed by a Director instead of a Statistical Adviser. Dr G. R. Seth became its first Director.

The research and technical work of the institute was organized in the following five divisions : Statistical Research in Crop Sciences, Statistical Research in Animal Sciences, Sample Survey Investigations, Training and Basic Research, and Computer Science and Numerical Analysis.

With the increase in the activities of data processing, the third-generation electronic computer, Burroughs 4700, was installed in the new Computer Centre building. The system was inaugurated by the Acting-President of India, Mr B. D. Jatti, on 11 March 1977.

The name of the Institute was changed to Indian Agricultural Statistics Research Institute (IASRI) with effect from 1 January 1978. With the growing research activities of the Institute, two more research divisions, viz. Crop Forecasting Methodology and Econometric Analysis, were formed in September 1978 and November 1978 respectively All these divisions are headed by the Heads of the Divisions To share the responsibilities of the Director, two Joint Directors were also appointed during 1978.

CHAPTER 27

# AGRICULTURAL UNIVERSITIES

Genesis and Ground Work; Reports of the First and Second Joint Indo-American Teams; Cummings Committee Report; Relationship of Indian Agricultural Universities and the U.S. Land Grant Universities; Report of the Education Committee, 1964-66; Report of the Review Committee on Agricultural Universities; Role of the ICAR in Agricultural Education

HIGHER education in Agriculture had a low status before Independence. Best students were attracted by the professions of medicine, engineering and law. Thus, barring a few exceptions, only those who were left out joined agricultural colleges. In 1948 there were only 17 agricultural colleges in India and facilities for training in postgraduate research work in agricultural sciences were available for only 160 students.

Agriculture and education are allocated to the States. Thus all agricultural colleges were under the immediate supervision and control of the departments of agriculture, whereas veterinary colleges were responsible to the veterinary departments or departments of animal husbandry in the State. All agricultural and veterinary colleges were affiliated with a university which controlled examinations, curricula and standards. Each college was headed by a principal who reported directly to the director of agriculture or veterinary. Although the principal had on paper the responsibility for operation of his college, he usually lacked sufficient authority to make the required decisions. The director of agriculture made some decisions, but even he did not have full authority to act without the approval of the secretary of agriculture. Financial support for the colleges was channelled through the department of agriculture in the State.

Agricultural (crops) education and animal husbandry (livestock) education were separated, with animal husbandry being incorporated into the veterinary colleges. In some States these agricultural and veterinary colleges were in different locations and had little contact.

Research and extension programmes were the function of the State departments of agriculture and animal husbandry. Research techniques were often poor, and the research tended toward theoretical problems rather than toward applied research specifically oriented to

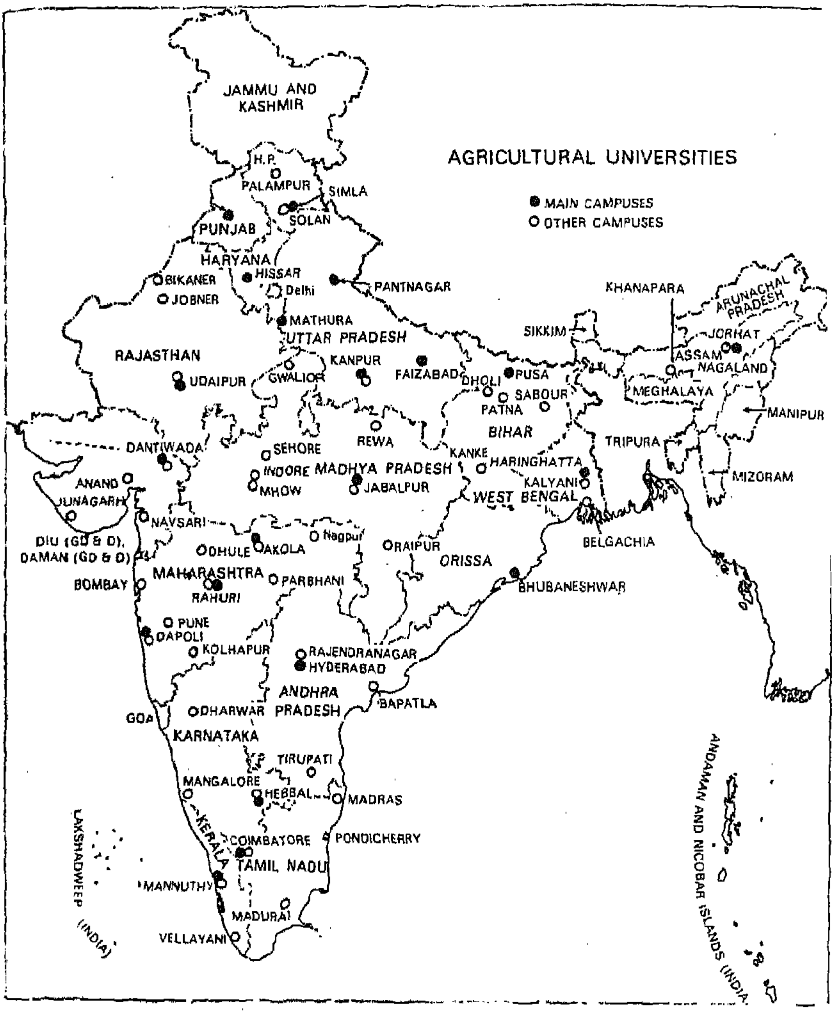



Fig. 29. Agricultural universities in India

solving the country's serious production problems. There was a particular lack of significant research on livestock problems. The agricultural extension work of the State departments of agriculture included service and regulatory activities in addition to extension education, with the result that the latter was neglected. Extension workers placed emphasis on supplying the basic materials and services to the cultivators, with lack of corresponding attention to instructions about ways to make most effective use of these materials and services.

The objective of the students was that of passing the annual examinations, and all teaching and learning were oriented toward that end. Students memorized the lecture notes, with little use of outside reference books or questioning of the material. The system discouraged teacher or student initiative and intellectual curiosity.

### University Education Commission (1949)

In 1948-49 the University Education Commission under the chairmanship of Dr S. Radhakrishnan recommended that a system of rural universities be established to supply skilled persons that would be needed by the country and to meet the requirements of an educated citizenship. The Commission observed, "A new beginning is desirable, with freedom to create a distinctive tradition as to purposes, spirit and methods".

Principal features of the proposed rural universities were mentioned by the Commission in general terms. A rural university should include a ring of small resident undergraduate colleges, with specialized and university facilities in the centre. While the need for a common core of liberal education in the basic sciences and social sciences was recognized, it was stressed that the curriculum should fit the needs of individual students and should provide for specialization and selection of courses from more than one college. Each rural university should be autonomous and free to work out its own programme in its own way, in terms of syllabi, curricula, evidence of completion of work, and examinations. Through its concept of rural universities, the University Education Commission introduced the Land-Grant College philosophy into India.

### Visit of Mr A. N. Jha and Major H. S. Sandhu to the USA (1950)

The earliest advocate of the agricultural university idea was Pandit Govind Ballabh Pant, formerly Chief Minister of Uttar Pradesh, and later Home Minister of the Government of India. He had given great

support to Major Harpal Singh Sandhu in the reclamation of *tarai*. In 1950 Major Sandhu and Mr A. N. Jha, Chief Secretary and Development Commissioner of U.P., visited the United States and were impressed by the Land-Grant Universities and the contribution they had made in developing agriculture in that country. On return they reported to Pantji that establishment of such a university in the reclaimed area of Rudrapur in the *tarai* would give an impetus to agriculture in that area. Pantji accepted their advice. This event ultimately led to the fruition of the schemes for agricultural universities

FIRST JOINT INDO-AMERICAN TEAM (1955)

The First Joint Indo-American Team was set up on the advice of Dr Frank W. Parker, who was T.C.M. Adviser to the Ministry of Food and Agriculture, Government of India. It had five Indian and three Americans. The American members were Mr A. H. Moseman, U. S. Department of Agriculture; Dean R. E. Buchanan, Iowa State University; and Dean E. E. Leasure, Kansas State University. Indian members included Mr K. R. Damle, Vice-President of the ICAR Mr B. N. Uppal, Agricultural Commissioner; Mr L. Sahai, Director of the IVRI, Mr H. K. Nandi, Director of Agriculture, Government of West Bengal; and Mr J. V. A. Nehemiah, Secretary, ICAR. The Indian members of the First Joint Team visited the United States from January to March 1955, while the American members came to India in July 1955.

The team endorsed the recommendation of the University Education Commission that wherever possible each State should develop a rural university. Particular places that the team felt were ready for consideration of a rural university included Uttar Pradesh (*tarai*), West Bengal (Haringhatta), Bihar (Patna), Orissa (Bhubaneshwar), Travancore-Cochin, and Bombay State (Anand). Secondly, the team suggested that postgraduate schools be established by the Government of India at the IARI and the IVRI among other places.

SECOND JOINT INDO-AMERICAN TEAM (1960)

The Second Joint Indo-American Team, set up on 12 September 1959, was headed by me as Vice-President of the ICAR. It had three representatives of American Land-Grant Universities, viz. Dean Arthur D. Weber, Dean A. E. Darlow and Dean Arthur L. Deering, and Dr Martin G. Weiss representing the U. S. Department of Agriculture. The Indian members of the Team were Dr B. N. Uppal, Dr L. Sahai, S. Lal Singh, Mr P. D. Nair, Dr M. D. Patel,

Dr K. C. Nair (Secretary), Dr J.S. Patel and Mr Ibne Ali.

The Team submitted its report on 11 July 1960, and recorded that there was widespread demand from many States for the establishment of agricultural universities. The Team recommended that assistance in establishment of an agricultural university should only be granted when there was adherence to basic principles such as: (1) autonomous status, (*ii*) location of agricultural, veterinary, animal husbandry, home science, technological and science colleges on the same campus, (*iii*) integration of teaching by offering courses in any of these institutions to provide a composite course, and (*iv*) integration of education, research and extension.

HANNAH'S BLUEPRINT ON AGRICULTURAL UNIVERSITIES (1956)

The work of this Team was greatly facilitated by a blueprint on agricultural universities prepared by Dean H. W. Hannah in 1956. The contribution made by him to this scheme while he was living at *tarai* farm that had been reclaimed from a marsh and scrub forest is basic. On the basis of this blueprint the Uttar Pradesh Government submitted a proposal to the Government of India in September 1956 to establish an agricultural university at Rudrapur in *tarai*, now called Pantnagar. The Government of India approached the problem in a cautious manner and agreed to the setting up of the agricultural university in *tarai* only as an experimental measure in the Second Five-Year Plan. However, there was demand from many more states for such universities, and in 1961 the Government of India accepted the need for a few more such universities during the Third Plan period and suggested that the existing colleges or institutions which had strong departments for teaching and research should serve as nuclei for such universities.

CUMMINGS COMMITTEE REPORT (1960-62)

In 1960 the Government of India appointed a committee headed by Dr Ralph W. Cummings to advise the State Governments on the legislation for the establishment of agricultural universities. The main idea was that the new agricultural universities should have the essential features that characterize the system and that they have a uniform base to carry on the functions with which they were charged. The report of the Committee, published in 1968, spelled out the distinctive features of the agricultural universities compared with the existing universities and provided guidelines for their development. On the basis of the

recommendations made by this Committee, the ICAR developed a model act which could be adopted with such changes as were necessary by the newly-developing agricultural universities. This was an important milestone in the development of these universities.

AGRICULTURAL UNIVERSITIES (1960-65)

From 1960 to 1965 seven agricultural universities came into existence in the States of U.P., Orissa, Rajasthan, Punjab, Andhra Pradesh, Madhya Pradesh and Mysore (Karnataka), during the Fourth Five-Year Plan period. The development patterns as also the functions and responsibilities delegated to these universities, however, varied from State to State and in some cases did not strictly conform to the central concept behind this institution-building process as laid down in the Model Act for Agricultural Universities.

RELATIONSHIP OF INDIAN AGRICULTURAL UNIVERSITIES WITH THE U.S. LAND-GRANT UNIVERSITIES

The T.C.M. (later A.I.D. programme) that started in India in 1956 for agricultural education was on a regional basis. The trend toward one agricultural university for each State took shape in 1960 and all A.I.D. support has been on a State basis since 1963. Eight agricultural universities were assisted by the Agency for International Development through six U. S. Land-Grant institutions.

Through USAID and these U. S. universities, assistance was given for training faculty members in Indian agricultural universities. In 1968 there were 4 500 returned participants from AID programmes, and over one-fourth were related to agriculture, veterinary medicine, engineering and home science. Specialists from the U. S. universities served with Indian counterparts in teaching, research and extension education in the agricultural universities. Other AID assistance included limited amounts of equipment for teaching and research.

REPORT OF THE EDUCATION COMMISSION (1964-66)

The impact that the scheme of agricultural universities made on policy-makers is evident from the report of the Education Commission (1964-66), headed by Dr D. S. Kothari, the then Chairman of the U.G.C. The Commission recommended the establishment of at least one agricultural university in each State. It further recommended that all apsects of research on agriculture should be the concern of the agricultural universities. Implementation of these recommendations further enlarged the area under the control of these universities.

It led to the integration of teaching, research and extension education where it did not exist. That an agricultural university provides a better environment for research than a State Department of Agriculture was realized in a number of States, and vested interests which believed in holding on to what they possessed untimately yielded to the pressure of progressive groups.

REPORT OF THE REVIEW COMMITTEE ON AGRICULTURAL UNIVERSITIES (1977-78)

The ICAR set up in January 1977, under my Chairmanship, a Review Committee to review the growth and development of agricultural universities in India. The Committee submitted a comprehensive report in June 1978. The Committee's overall assessment was that the agricultural universities together had made a tremendous impact on agricultural production during the short span of their existence. The Committee, however, stated that there was a high degree of variability amongst agricultural universities in achievement and output, quality of leadership and competence of faculty, degree of institutional development and maturity, magnitude of financial support from the State Governments, extent of transfer of research responsibilities to the university, quality and relevance of teaching and research programmes, operational efficiency and commitment to public service. The quality of leadership and degree of commitment and support from the State Governments have been identified as the main factors responsible for this variability in growth, performance and potential. The Committee therefore made the following recommendations.

1 The selection committee for choosing Vice-Chancellors should include Director-General, ICAR, and Chairman, UGC, as members in each case.
2 The Vice-Chancellor should be the chairman of a compact Board of Management with a membership not exceeding 15.
3 The State Government should adopt a positive policy of support to agricultural universities. First, they should review the University Acts and bring them in line with the Model Act recommended by the ICAR and implement it faithfully. They should transfer State-wide agricultural research responsibility to agricultural universities along with staff, farms, budget, buildings, equipment etc. Parallel research organization should not be set up in the State departments in the name of adaptive research. Secondly, agricultural universities are

essentially State institutions and hence State Government should accept direct responsibility for both the development and operational costs. The Central support from the ICAR could only be supplementary in nature.

4 The ICAR should use central assistance as an incentive and instrument to achieve the organizational pattern and institutional model of agricultural university with all essential features.

5 The ICAR should firmly adhere to the policy of having only one agricultural university in a State. For Uttar Pradesh and Maharashtra, which have three and four agricultural universities, the co-ordination mechanisms should be strengthened.

6 The existing agricultural complexes in Himachal Pradesh and Rajasthan attached to the general universities should be set up as separate agricultural universities. The possibility of establishing an agricultural university in Jammu and Kashmir should be explored with the State Government.

The Committee made several important recommendations for improving the practical training programmes promoting self-employment of agricultural graduates and for giving rural orientation to home science education. The Committee also made a number of recommendations for improvement in the education, research and extension programmes, staff development, strengthening of financial resources of the universities, development of infra-structure facilities and strengthening of machinery for planning, evaluation and co-ordination of universities. A brief review of the progress of each agricultural university along with some observations about some major aspects of their functioning is also contained in the report.

## Contribution of Agricultural Universities to Agricultural Production

The concept of integration of teaching, research and extension has already proved its worth through remarkable progress made in the field of agricultural education, research and extension by the new agricultural universities. There is perceptible improvement in the quality of education. There are more competent teachers, better-equipped libraries, laboratories and farms. The internal examination system is geared for continuous preparation on the part of both the students and the teachers.

These institutions are largely responsible for the development of the high-yielding varieties of wheat, maize, pearlmillet and sorghum. Unprecedented high crop yields have been recorded. Agronomic

and plant-protection practices to exploit maximum yiela potentials. have been developed and effectively extended to the farmers. These institutions today are serving as fountain-heads of new knowledge earned through purposeful, problem-solving research and have become dissemination centres of useful knowledge to farming community. Some of the best training for farmers is offered by the agricultural universities. They are producing numerous functional specialists who have gained confidence through experience in successfully applying scientific knowledge to the solution of practical problems.

The working conditions and incentives that they offer to the faculty and the students are providing opportunities for productive work, and are fostering team spirit and a healthy change in the outlook of all the teachers and the researchers and the government administration. They are winning confidence of the farmers. They have assumed leadership in science, education and extension. Their direct contribution to programmes like pedigree seed-production, fertilizer use and national crop demonstrations is highly impressive. In this connection the inter-institutional collaboration within the country and the international collaboration with the U. S. universities needs special mention. Agricultural universities are participating most effectively in the execution of the various co-ordinated programmes of agricultural research initiated by the ICAR.

Besides improvement in quality, the new system of education has reduced the 'wastage' in the higher education. This not only saves cost but provides training opportunities for more students.

It will not be out of place to quote some of the specific contributions made by the agricultural universities. The soybean projects operating at the U.P. Agricultural University, Pantnagar (GBPUAT), and Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, have demonstrated that a number of soybean varieties are highly adapted to these areas and the crop can be grown successfully. Introduction of sugarbeet on the eastern region of the U. P. is another example of a new crop adapted successfully in the region. The agricultural universities of U. P., Punjab and Andhra Pradesh have already made significant contributions in the cereal-improvement programmes co-ordinated by the ICAR in co-operation with the Rockefeller foundation. In the field of extension, the Tungabhadra fertilizer-use project executed by the University of Agricultural Sciences, Bangalore, is an outstanding example of speedy spread of new varieties of crops and agronomic practices among the farming

communities. The University took up the development of intensive farming in 4 047 ha of irrigated land under the project with the assistance from OXFAM and the USAID. The project has been highly successful. The College of Engineering of the PAU, Ludhiana, which has received considerable support from the Ford Foundation, has provided mucq-needed technical guidance to private companies which are now engaged in the manufacture of agricultural implements such as fertilizer-cum-seed drills, threshers, water-lift pumps, sprayers and dusters.

## ROLE OF ICAR IN AGRICULTURAL EDUCATION

According to its original aims and objectives, the ICAR was intended to undertake, aid, promote and co-ordinate agricultural education in the country. In practice, however, the Council played a very limited role before 1966 because it had neither the financial resources nor the statutory authority to discharge this responsibility. Although the concept of agricultural universities had been accepted and eight of them had come into existence by 1966, the financial support for their development remained highly inadequate, viz. below Rs 2.5 million per university during the Third Five-Year Plan.

The ICAR was reorganized in 1966, giving it the role in relation to the agricultural education as of the UGC in the case of general education. A full-fledged division of Agricultural Education was established in the Council to provide necessary leadership and support to accelerate the pace of development of agricultural universities.

During the last decade the ICAR has played a great role in reorganizing and consolidating agricultural education in the country. It helped to replace the traditional system by introducing course credit system, laying down modern courses and curricula for various courses and linking education to field problems.

The number of agricultural universities, which was eight in 1966, has gone up to 21. The financial assistance from the ICAR to agricultural universities, which was only Rs 12 million during the Third Plan, was increased to 417 million during 1974-75 to 1978-79 (the 4 years of the Fifth Plan). A liberal pattern of assistance (100%) was adopted for assisting the universities. To ensure certain minimum uniformity in the structure, organization and governance of these universities, the ICAR developed a Model Act in 1966. It is assisting the universities in the implementation of a number of schemes for improving the quality and standard of education and research, e.g. establishment of

Centres of Excellence, programmes of higher education in new areas, creation of chairs of Professors of Eminence, faculty improvement, means-cum-merit scholarships, and fellowships.

CHAPTER 28

# AGRICULTURAL UNIVERSITIES

## Phase 1 : 1960-65

In this chapter the first batch of agricultural universities which were established from 1960 to 1965 are described in chronological order. Only salient facts are mentioned, and no attempt is made to give lists of improved varieties of crops which the plant breeders in these universities claim to have evolved. For information of this nature, chapter on 'Advances in Research on Crops' be consulted, which covers the achievements of all research organizations in the country.

### GOVIND BALLABH PANT UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, PANTNAGAR (1960)

The Govind Ballabh Pant University of Agriculture and Technology (GBPUAT), established in 1960, is the first agricultural university, set up in India. The founder Vice-Chancellor was Mr K. P. A. Stevenson (1959-1964), an IAS officer. The most distinguished Vice-Chancellor of this University was Mr D. P. Singh (1966-75), who built up the University with dedication. It is a mono-campus institution with jurisdiction over 19 districts of Uttar Pradesh. It offers educational programmes in the fields of agriculture, agricultural engineering/technology, veterinary science and home science. The University has recently acquired a farm at Daurala and another at Rani Chauri in the hills to develop regional research and training facilities. The sanctioned strength of the staff in 1975-76 was 369, and the number of students on rolls was about 2 000.

This University has an impressive record of achievements to its credit in the field of education, research and extension education. It has all through laid emphasis on the quality and relevance of education and research, and has maintained its all-India character by accepting freely the best students and faculty members from any part of the country. As a result, it has a competent faculty which has made excellent contribution to the development of the agricultural university system in India. For example, the University introduced the pioneering programmes of practical training for agricultural and veterinary graduates, which is serving as a model to other agricultural universities. It has also initiated a number of programmes for promoting self-employment among agricultural and agricultural engineering graduates, even though the results of such eff-

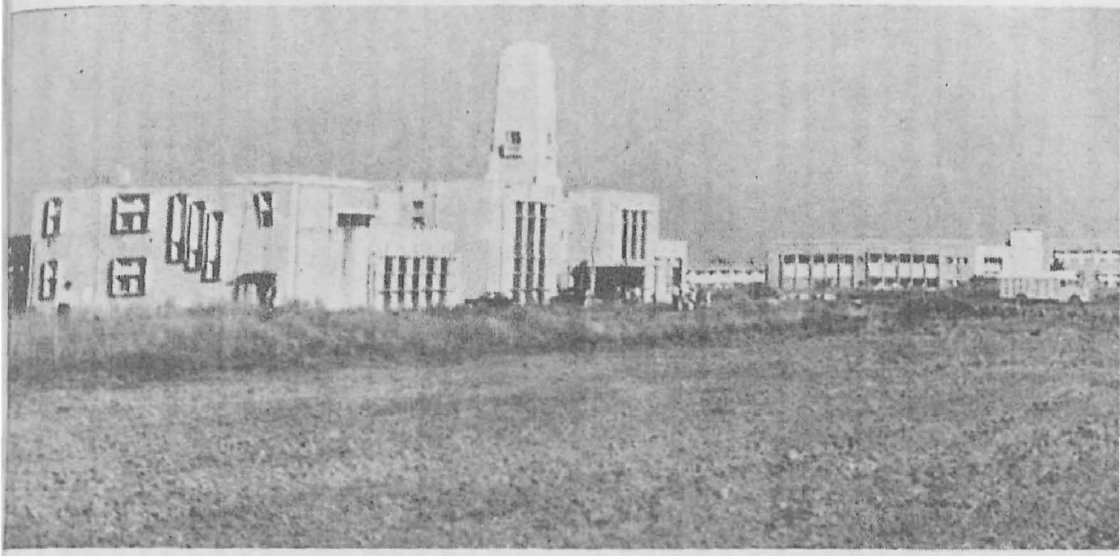


Fig. 30. Govind Ballabh Pant University of Agriculture and Technology, Pantnagar

Fig. 31. University of Udaipur, Rajasthan — College of Agriculture, Udaipur

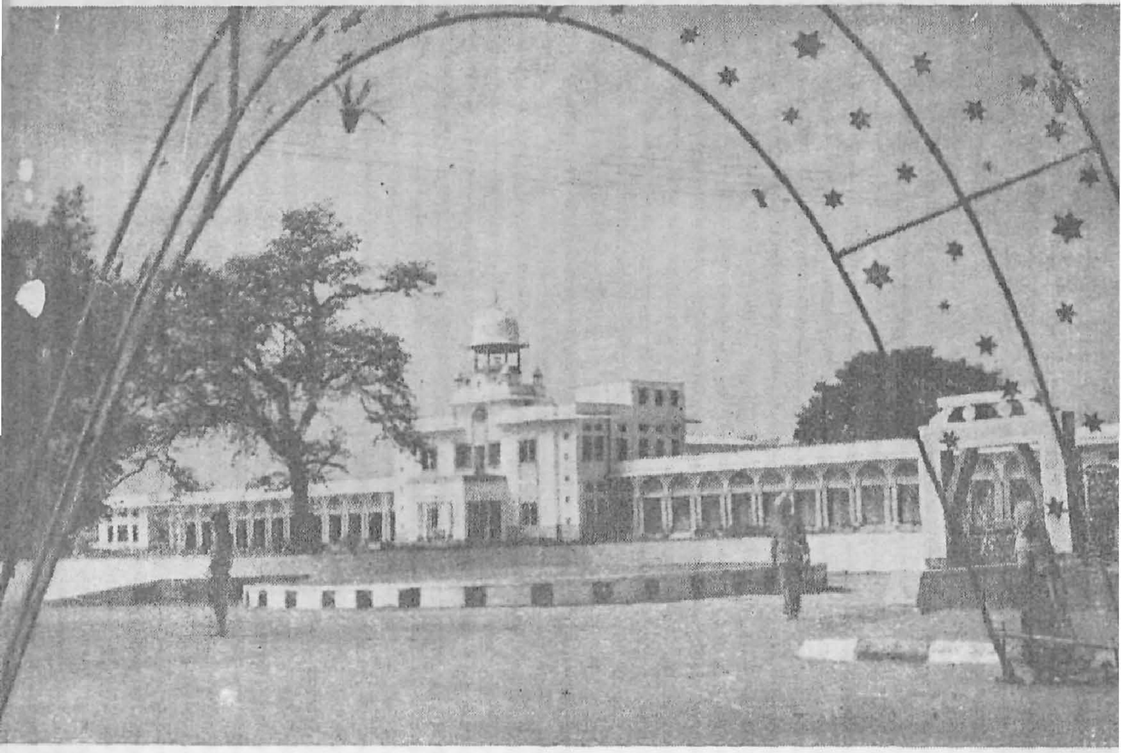



Fig. 32. Orissa University of Agriculture and Technology, Bhubaneshwar — College of Basic Science and Humanities

orts have not been encouraging. It has achieved reputation for the development of quality seeds, which are popular throughout the country. The research programmes are strong, and have the advantage of being backed up with the data available from a large experimental farm.

When the Uttar Pradesh Agricultural University was started, 5 767 ha of land was transferred to it by the State Government, so that the farm could provide the finances to the University, and also enable the students to earn while they learn. Excluding areas under roads, buildings, uncultivable portions and areas occupied by the experimental plots for research on crops, horticulture and livestock, the Pantnagar farm now has under commercial use an area of 4 095 ha. It has 159 tractors and 30 combines.

At the time of transfer of the farm to the University, hardly 10% area was under irrigation. It was soon realized that the irrigation resources like shallow tubewells and open wells with average discharge of 0.6 cusec were inadequate to meet the requirements of the farm. The progress of land levelling was also slow. In October 1969 a Master Plan was prepared for irrigation and land development works involving an expenditure of Rs 10.289 million. Emphasis was given on the construction of deep tubewells and artesian wells. The construction of these resources was taken up with the help of rotary rigs of the Central Ground Water Board, and one percussion drilling rig was purchased by the University and used for this work. It was planned to provide a total of 200 cusecs discharge, sufficient to irrigate 10 000 ha area. In addition to the deep artesian wells and tubewells, pumps were installed on the rivers flowing through the farm. Along with the provision of irrigation resources, planning of irrigation-conveying system was also planned. The farm is irrigated by 39 artesian wells, 50 tubewells and 40 open wells, Apart from that, 7% of the area is irrigated by canals.

*Education.* Educational programmes have been organized on sound footing and the quality of agricultural graduates is good. This is reflected in the fact that graduates from Pantnagar University do not face unemployment problem. However, education and research programmes in Home Science need to be reoriented to serve the rural interest as in the case of other universities

The College of Veterinary Science operates a programme of livestock extension work in the neighbouring villages, and charges the cattle owners for veterinary services at a subsidized rate (50% of the treatment cost). The college earned about Rs 50 000 in one year by rendering such

services. The University has also constructed a number of fish farms for producing spawn to be used by the State Government for fish propagation.

*Communication centre and library.* The Communication Centre of the University is housed in the College of Agriculture. The library is housed in a building constructed in 1963. The average daily attendance in the library is about 400 students and 150 faculty members. The University has successfully launched a scheme of producing textbooks in Hindi, both through translation and writing of original books, financed out of the funds provided by the State and Central Governments under a scheme for production of textbooks in Hindi. The University has also introduced a Hindi-medium section for undergraduate programme in agriculture.

By its research and its extension to the farmers, the University has transformed the *tarai.* Tractors, threshers and tube-wells are a common sight. On account of plentiful supply of ground-water, this area is exceptionally favourable for intensive agriculture. Hence, the *tarai* of Uttar Pradesh can be claimed to be one of the Green Revolution areas of India.

UNIVERSITY OF UDAIPUR, UDAIPUR (1962)

In early 1962 the Government of Rajasthan invited Dr Ralph W. Cummings to help draft a bill for the establishment of an agricultural university in the State. As a result, the Rajasthan Agricultural University was established and the three colleges, viz. Rajasthan College of Agriculture, Udaipur; S. K. N. College of Agriculture, Jobner; and Rajasthan College of Veterinary and Animal Science, Bikaner, were transferred to it. The University was inaugurated on 12 July 1962.

The first Vice-Chancellor of this University was Mr G. B. K. Hooja (1962-63), an IAS officer. He was followed by Dr G. S. Mahajani, an educationist, who had retired as Vice-Chancellor of Delhi University in 1963. Dr Mahajani served as Vice-Chancellor of this University from 1963 to 1972. Dr P. S. Lamba, an agricultural scientist, was the Vice-Chancellor from 1973 to 1977. The present Vice-Chancellor is Dr Ranbir Singh.

Initially the University had only two faculties, viz. that of Agriculture with two campuses at Udaipur and Jobner, and of Veterinary and Animal Science at Bikaner. In 1963 the Act was amended to facilitate accession of other colleges within the municipal limits of Udaipur and to make the University a multi-faculty institution. This was an unfortunate decision.

The name of the University was changed to University of

Udaipur and the following colleges were disaffiliated from the Rajasthan University and transferred to the Udaipur University, viz. Maharana Bhopal College, R. M. V. Home Science College, Vidhya Bhawan Govindram Seksaria Teachers' College, Bhopal Nobles College, Shramjeevi College, Udaipur School of Social Work, and Meera Girls College. In 1965, Vidya Bhawan Rural Institute, Udaipur, was associated with the University as the Arts and Science College. Later on, in 1966, Lokmanya Teachers' Training College, Dabok, was associated with the University.

Though the University became a multi-faculty, still the emphasis was on agriculture.

The University has 10 faculties and a complex of constituent colleges of an agricultural university plus some associated colleges. The faculties include those of Agriculture, Veterinary and Animal Sciences, Agricultural Engineering, Home Science, Basic Sciences, Humanities, Social Sciences, Commerce, Law and Education. The sanctioned strength of the staff at these institutions in 1975-76 was 365, and the number of students on rolls was about 1 600

Whereas the instructional campuses of the University are confined only to Bikaner, Jobner and Udaipur, 10 Research Stations and 10 Extension Education Centres are spread all over the State, to serve the different agro-climatic zones

*Agricultural experiment station.* The Agricultural Experiment Station, the research component of the University, was established in 1963. It started functioning with an outlay of Rs 10 000 in 1963-64 with limited facilities. The State Government transferred the research laboratories of Agricultural Chemistry, Plant Pathology and Entomology located at Udaipur in 1963. The University acquired a research farm at Vallabhnagar, 45 km away from Udaipur, in 1966. The Government transferred to the University the fruit farm and seed multiplication farm at Banswara in 1969, and a project on sesamum financed by the ICAR under Oilseed Imporvement Programme. The Sumerpur farm was transferred to the University in 1972.

All research stations were transferred to the University from the Department of Agriculture on 1 April 1976. Facilities in the form of farms, funds and manpower were also increased. During 1978-79 the financial outlay was Rs 18 million with a strength of 1 240 (450 scientific and 790 supporting staff) in research component alone.

*Research.* A high-yielding and good-grain variety of wheat 'Raj 1418', which is tolerant to root nematodes as well as the rusts, has been

released. A salinity-resistant barley variety 'BL 2' has been developed. Another variety of barley, 'RD 387', capable of yielding 50 q in a nematode-infested field, has also been evolved. Six promising high yielders of *bajra* have been identified which are resistant to downy mildew.

*Extension.* The University established its Directorate of Extension Education in 1966 to undertake extension programmes in agriculture, animal science, rural industry, agricultural engineering, veterinary science, home science and other allied sciences. The activities of the Directorate include organizing National Demonstrations, Farmers' Trainings, Officials' Trainings, Rural Youth Organization, Farm Publications, Periodicals, Correspondence Service, Farm Advisory Service, Agricultural Exhibitions, Nutrition Extension, and *Kisan Melas* (Farmers' Fairs).

A Krishi Vigyan Kendra was started with the assistance of the ICAR at Fatehpur in Sikar district during 1976-77.

### ORISSA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, BHUBANESHWAR (1962)

The Orissa University of Agriculture and Technology (OUAT) was established in August 1962, and is the third oldest agricultural university in India. It is a mono-campus institution, offering educational programmes in three faculties—Agriculture, Agricultural Engineering and Veterinary Science. There is a College of Basic Science and Humanities which is offering intermediate-level programmes.

The first Vice-Chancellor was Mr N. C. Pradhan (1962-65). He was followed by Dr K. Ramiah (1965-68), well-known rice-breeder. The present Vice-Chancellor is Dr K. Kanungo.

The University is expected to receive assistance from the International Bank for Reconstruction and Development-Orissa Extension and Research Project, through which some regional research stations are proposed to be strengthened. Presently, the sanctioned strength of the staff is 192 and the number of students on rolls (undergraduates and M. Sc.) is about 1 000.

### PUNJAB AGRICULTURAL UNIVERSITY, LUDHIANA (1963)

On account of partition of India on 15 August 1947, the famous Lyallpur Agricultural College fell to the share of Pakistan. The refugee farmers of Ludhiana, who mostly came from Lyallpur Canal Colony, knew the benefits of an agricultural college. They vacated a school building to house the agricultural college. About 404 ha of land in an evacuee village was allotted to the college in 1950. By 1955 a modern

building was built for the College of Agriculture. In 1962, due to the interest taken by the Chief Minister S. Partap Singh Kairon who was keenly interested in agricultural development, Ludhiana was selected for development as an agricultural university. The University was formally inaugurated by Pandit Jawaharlal Nehru on 8 July 1963. Owing to the dedicated efforts of the first Vice-Chancellor, Mr P. N. Thapar, and the enthusiastic support of the Chief Minister Kairon, the University made rapid progress.

Established on the pattern of Land-Grant Colleges of the USA, the Punjab Agricultural University provides graduate and postgraduate instructions in agriculture, veterinary and animal science, agricultural engineering, home science, and basic sciences and humanities. The University makes provision for instruction in applied fields, for research and for the spread of the findings of research and other technical information through a programme of extension education. It is thus responsible for the three functions of teaching, research and extension education in agriculture and allied fields for the Punjab State.

The University campus at Ludhiana occupies an area of 578 ha including a research farm covering about 512 ha. Besides, 10 regional research stations and substations cover an area of 481 ha. Two seed farms are also established over an area of 476 ha.

*Finances.* The University is financed mainly by the Punjab Government. Of the total budget of Rs 85.271 million for 1978-79, the State Government's contribution is Rs 60.514 million. The ICAR contributed Rs 17.235 million and other sources of Rs 7.522 million. Rs 42.259 million have been earmarked for research, Rs 28.172 million for teaching, Rs 6.487 million for extension education and Rs 8.353 million for miscellaneous expenditure.

*Library.* An impressive and elegant building accommodates the University's Central Library, which is named after its second Vice-Chancellor, Dr M. S. Randhawa. The total titles of this library are 165 923, of which 131 547 are books, 34 124 bound periodicals and 252 micro documents. The library membership is extended to 3 981 readers.

*Teaching.* The university has five constituent colleges, viz. the College of Agriculture, the College of Basic Sciences and Humanities, the College of Agricultural Engineering, the College of Home Science and the College of Veterinary Science. Besides, it has three directorattes, viz. the Directorate of Research, the Directorate of Extension Education and the Directorate of Students' Welfare. There are 43 depart-

ments with faculty strength of 1 095. There are 2 653 students on the rolls, including 186 from foreign countries.

There is also a postgraduate organization headed by the Dean of Postgraduate Studies. The postgraduate instruction in formal courses is offered in agriculture, basic sciences, veterinary science, agricultural engineering and home science.

*Research.* Research carried out at the PAU has brought about the Green Revolution in Punjab, and made it the granary of India. As a result of the introduction of high-yielding wheat and rice varieties and their large-scale adoption, along with advanced technology, by the farmers of the State, the production of wheat increased three times, i.e. from 1.92 million tonnes in 1965-66 to 6.27 million tonnes in 1976-77, and that of rice six time, i.e. 0.29 million tonnes in 1966 to 1.85 million tonnes in 1977. The increased farm production has improved the economic status of the farming community of the State.

The University has developed and released 23 improved vegetable varieties of tomato, muskmelon, brinjal, turnip etc.

High-quality grape varieties such as 'Perlette' and 'Thompson Seedless' have been successfully introduced in the State. Similarly, peach cultivar 'Floridasun' has been introduced from the USA.

A herd of 300 buffaloes has been developed with an average 305-day lactation yield of 2 100 litres. Through progeny-testing, 100 male calves and bulls have been obtained from the high-yielding dames. They have been reared for distribution to Animal Breeding Centres in the State

The veterinary scientists have achieved a breakthrough in the treatment of bovine theileriasis by evolving a vaccine which has been recognized by the FAO for field-testing

Many new machines for efficient sowing, harvesting and threshing of crops have been developed. These include potato digger, groundnut digger-shaker, multi-crop thresher, bullock- and tractor-operated reapers, and multi-crop seed drill. These machines have greatly contributed to the mechanization of agriculture, and have helped the farmers in multiple cropping.

*Extension.* The University has earned the distinction of being the Asia's largest farmer-training centre. Every year over 250 training courses are organized, involving over 8 000 farmers, dairymen, poultry keepers, young farmers, farm women and extension workers. Specialized training courses in farm machinery, poultry, dairy farming, piggery, fruit and vegetable cultivation and preservation are popular with

the farmers.

*Communication centre.* The Communication Centre provides a bridge between the University and the farmers through the press, radio, television and publications. It has done a commendable job by introducing written material into almost every farm home in the State.

The Centre publishes two monthly journals—*Progressive Farming* (English) and *Changi Kheti* (Punjab). These are sold to the farmers at 500 distribution points through newspaper agents. Extension bulletins published in English and Punjabi on various aspects of crop production, animal sciences and agricultural engineering are sold in thousands every year. Besides, two half-yearly books, viz. *Package of Practices for Kharif Crops* and *Package of Practices for Rabi Crops*, and an annual digest called *Punjab Agricultural Handbook* are also published.

*Contributions of Vice-Chancellors.* Mr P. N. Thapar, ICS (retired), was appointed the first Vice-Chancellor of the PAU. Mr Thapar realized the value of education in agriculture. He is one of the seasoned administrators of the country. During his tenure the University became a premier institution for agricultural education and research in Asia.

Dr M. S. Randhawa, ICS, took over as Vice-Chancellor in 1968. An able administrator, a scientist and an art critic, he provided dynamic leadership to the University. During his tenure, College of Veterinary Science was started at Ludhiana. A number of new buildings, e.g. the College of Basic Sciences and Humanities, Kairon Kisan Ghar, Central Library, Museum of Water and Power Resources of Northern India, Museum of Rural Life of Punjab, Students' Home and the Communication Centre, were built. New crop varieties were discovered by which the Green Revolution in the State became a reality. He made the University the farmers' university in the true sense.

The present Vice-Chancellor, Dr A.S. Cheema, took over in 1976. He is a distinguished agricultural scientist with specialization in extension. He was the Director of Agriculture, Punjab, Agricultural Commissioner to the Government of India, and later Agricultural Advisor to the World Bank. Dr Cheema has keen interest in rural development.

*Recognition and awards.* Dr M. S. Randhawa, the former Vice-Chancellor, and Dr D. S. Athwal, former Professor of Plant Breeding, were awarded Padma Bhushan, whereas Dr Amrik Singh Cheema, the present Vice-Chancellor and Dr K. Kirpal Singh, present Dean of Postgraduate Studies, were awarded Padma Shri by the President of

India for their contributions in promoting modern agriculture in Punjab.

Besides, more than 30 scientists of this University have obtained national awards like the Shanti Swaroop Bhatnagar Award, Rafi Ahmed Kidwai Award, Invention Promotion Award and other awards for their contributions to scientific research.

*Role in green revolution*. The role of the PAU in Green Revolution is thus described by P. C. Aggarwal, a perceptive observer :

'Twice a year the University organizes *Kisan Melas* on the Campus where farmers from all over the Punjab, and other States, come in large numbers. The University virtually turns itself out on these occasions and allows the visiting farmers to see what is being done there. All the new varieties of plants are put on display together with full details about their merits and their methods of cultivation. At the same time, improved machines and animals are exhibited. Scientists explain their research findings and discuss them with the visiting farmers.

'Formal question-and-answer sessions are organized where farmers can discuss specific problems with the scientists.

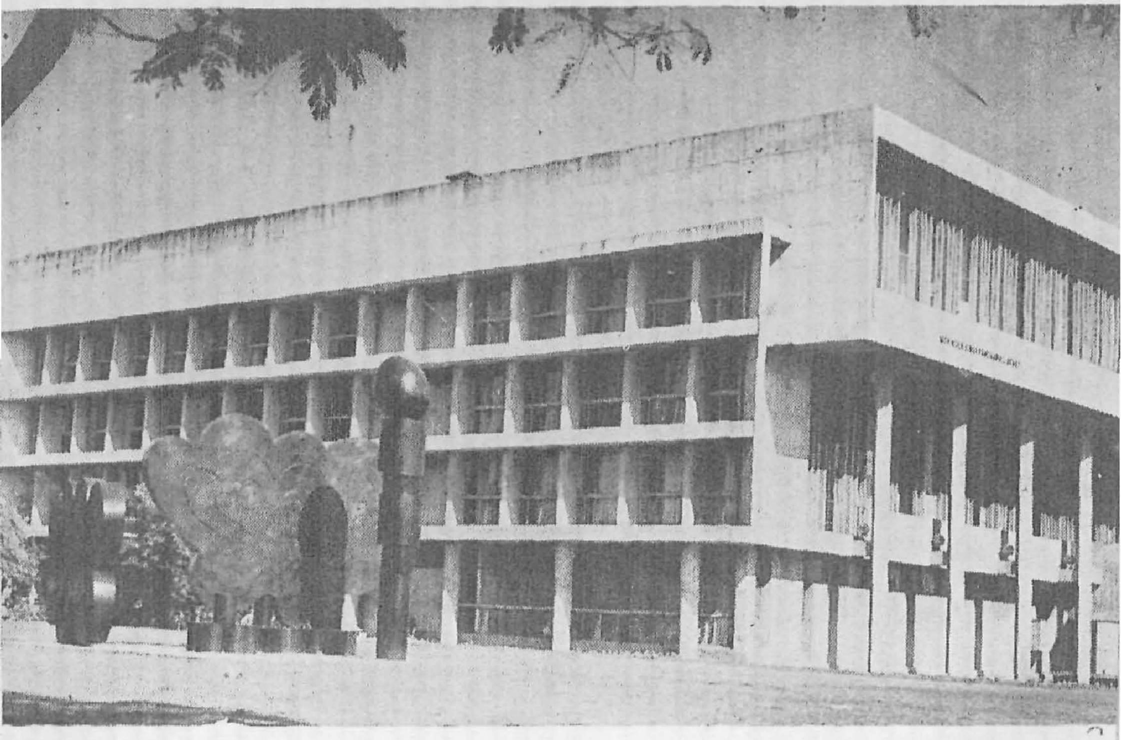
'During the nine years of its existence, the University's scientists have evolved a number of improved seeds, found ways to control plant and animal diseases, designed new machines, and developed more efficient techniques of production. Economists and other social scientists of the University have done a great deal of research on diffusion of innovations, communication patterns, marketing of crops, farm mechanization, and employment. Most of their research has been on current problems and it has led to significant improvements in all aspects of agriculture in the district and the State.

'Two important points need to be underlined about the contributions of the University. One is that for the first time in the recent history of India, scientists have gained respectability in the eyes of the farmer. The latter have realized the value of scientific research. Farmers seem to understand that in order to use modern technology effectively they have to depend on the scientist. On many occasions farmers have spontaneously organized meetings to honour scientists. One can easily imagine the effect of such social recognition on the morale of an otherwise meagrely paid college professor. Several Panchayat Samitis and Zila Parishads have voluntarily contributed money in support of the University's activities.

'A second notable point is the development of a close relationship between the University and the farmers. The University extends itself to the farmer through its distinctive teaching methods which require

Fig. 33. Punjab Agricultural University, Ludhiana — administrative block

Fig. 34. Punjab Agricultural University, Ludhiana — Dr M. S. Randhawa Library



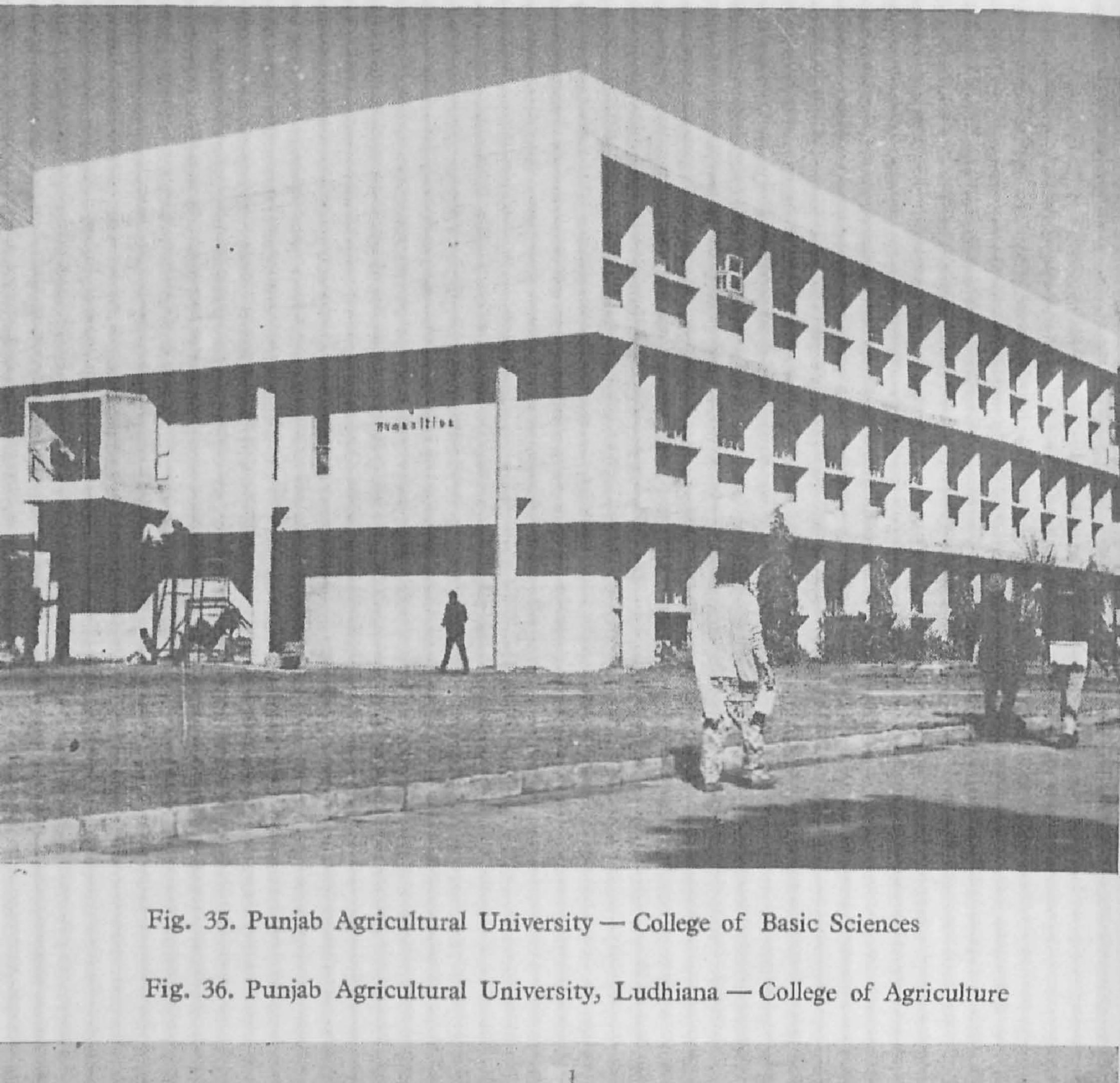


Fig. 35. Punjab Agricultural University — College of Basic Sciences

Fig. 36. Punjab Agricultural University, Ludhiana — College of Agriculture

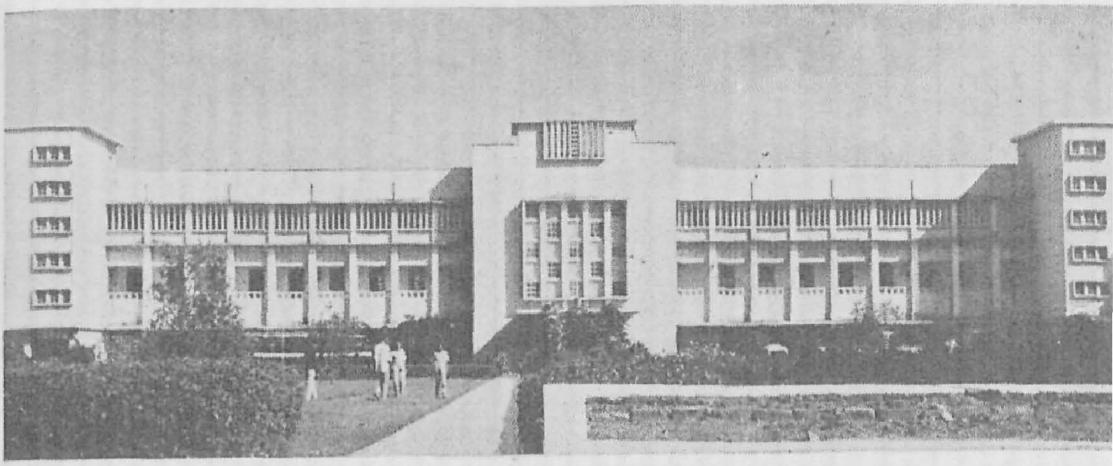
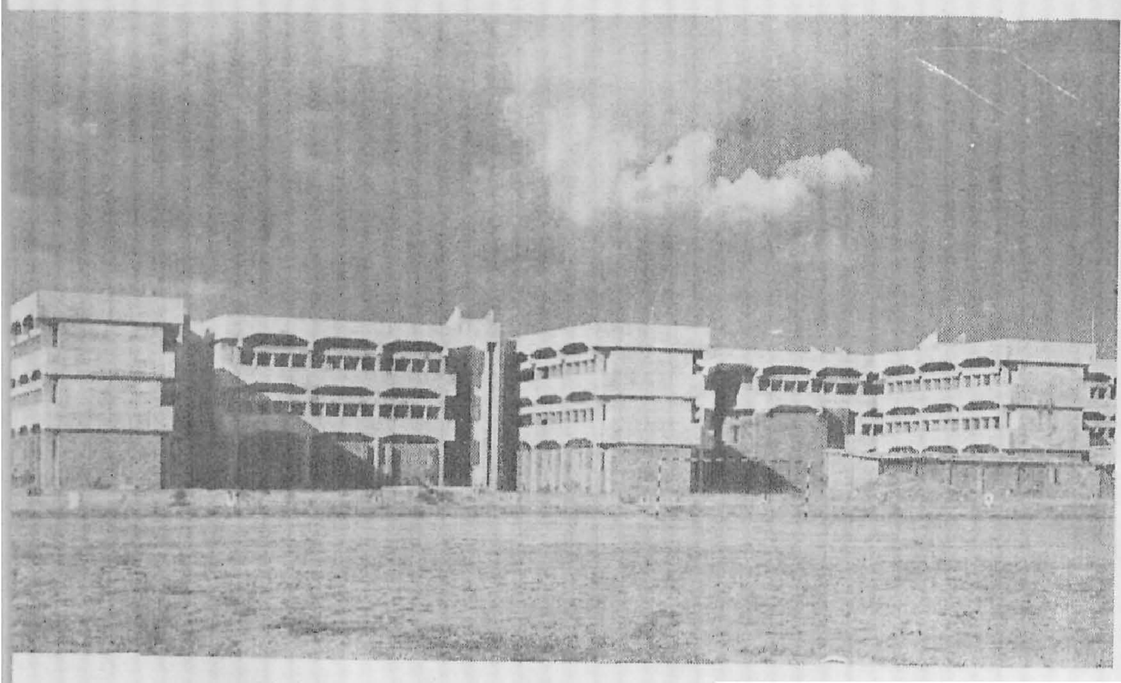


Fig. 37. Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur

Fig. 38. Andhra Pradesh Agricultural University, Hyderabad

Fig. 39. University of Agricultural Sciences, Hebbal, Bangalore —
College of Agriculture

Fig. 40. Mahatma Phule Krishi Vidyapeeth, Rahuri



students to visit farms and homes, and set up demonstration plots in the villages. Visits to the villages by the faculty members for research and discussions are also frequent. The farmers are drawn to the university through 'Kisan Melas' ; farm competitions; field days; demonstration centres; pure seed depots; discussion forums; specialized training courses for young farmers; and special fruit preservation and crop husbandry courses for women. They also run their own services for soil and water testing, plant protection, artificial insemination, planning and planting orchards, veterinary treatment, custom hatching of pedigreed eggs, guidance on dairy production and pig-keeping, agricultural information and broadcasting and lately an adivsory service for designing and building farm houses, cattle and poultry sheds, grain stores and tubewells.

'By 1960-61, a strong base for development had been established so that when the IADP, the Agricultural University, and the HYV seed came in quick succession, agriculture was transformed.'[1]

## JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA, JABALPUR (1964)

Jawaharlal Nehru Krishi Vishwa Vidyalaya was established on 1 October 1964 by an Act of the Madhya Pradesh Legislature passed in 1963. The headquarters of the University is located at Jabalpur, 7 km north of the town.

In December 1964 the Government of Madhya Pradesh transferred six colleges of agriculture and two colleges of veterinary science and animal husbandry, and 19 research farms and stations to the University. The colleges of agriculture are located at Jabalpur, Rewa, Raipur, Sehore, Indore and Gwalior; and the colleges of veterinary science and animal husbandry at Jabalpur and Mhow. The student strength in six agricultural colleges, two veterinary colleges and one agricultural engineering college was 2 500, and the faculty strength (1975-76) was 553.

The first Vice-Chancellor was Dr J. S. Patel (1964-1968) who had retired as Agricultural Commissioner to the Government of India. He was followed by Dr L. S. Negi (1968-1972). Since Dr Negi left there have been seven Vice-Chancellors.

The University started functioning in the Third Five-Year Plan. Some of the significant achievements made during the Fourth Plan were·

[1]Aggarwal, Partap C. *The Green Revolution and Rural Labour—A Study in Ludhiana*, pp. 117-120

introduction of trimester system of examination by internal assessment; integration of teaching, research and extension education, establishment of the Extension Directorate; construction of hostels, staff quarters, guest-house and other amenities at Jabalpur and the outlying campuses; starting of the College of Agricultural Engineering from July 1967; strengthening of research, under the All-India Co-ordinated Projects of the ICAR; and consolidation of postgraduate teaching up to M. Sc. (Agric.) and M.V.Sc. level; and starting of the Information and Public Relations Section in July 1967.

The University switched over to semester system of education, replacing trimester system in 1972.

There are four faculties—Agriculture, Veterinary Science and Animal Husbandry, Agricultural Engineering, and Basic Sciences and Humanities.

Research facilities are available for Master's degrees in all the colleges, where postgraduate classes are held, and also in the regional research stations. Main areas of research are improvement of crops, soil-fertility status and animal nutrition, production of improved vegetable varieties, pest control, animal diseases, cross-breeding of dairy cattle, poultry and pigs, development of vaccine against animal diseases, study of agronomic and physiological barriers, improvement of farm machinery, soil conservation and water management, etc.

Extension strives to keep the personnel of the State Departments of Agriculture and Veterinary abreast of latest research information on agriculture, veterinary and home science, and to bring research and teaching personnel into direct contact with the farmers' problems.

*Research.* The research work in the JNKVV is carried out at nine college campuses and 17 research stations or substations. In view of the varied agro-climatic regions, the research work on important crops is carried out at these research stations.

The research in Veterinary and Animal Sciences is related to increase in animal productivity; e.g. milk, meat and eggs. To make the research fruitful, it is problem-oriented and is integrated with teaching and extension programmes.

Stress is being laid on designing improved implements which can give higher efficiency or output per unit time without replacing the bullocks. The strategy is to develop intermediate technology which could be used by small farmers as well.

A number of improved varieties of cereals, pulses, oilseeds, cotton, lesser millets and vegetables have been released. The management of

heavy clay soils in *kharif* has been studied and recommendations made.

ANDHRA PRADESH AGRICULTURAL UNIVERSITY, HYDERABAD (1965)

The Andhra Pradesh Agricultural University was established in June 1964, and was formally inaugurated on 20 March 1965 by Mr Lal Bahadur Shastri, the then Prime Minister of India. It caters to the needs of the entire State, which is a predominantly agricultural with a gross cultivated area of over 13 million ha. The State Government transferred research responsibility to the University in 1966 along with staff and 6 000 ha of land and laboratories.

*Education.* The University has three faculties—Agriculture, Veterinary Science and Home Science. The establishment of the faculties of Basic Sciences and Humanities, Agricultural Engineering and Dairy Science is under active consideration. The University has six constituent colleges—three in Agriculture, two in Veterinary Science and one in Home Science. The three agricultural colleges are located at the three campuses, viz. Rajendranagar, Bapatla (in the coastal district of Guntur) and Tirupati (in the southernmost district of Chittoor) whereas the two colleges of Veterinary Sciences are located at Rajendranagar and Tirupati, and the College of Home Science at Hyderabad. In 1975-76 the sanctioned strength of staff was 450 and the number of students on rolls 2 400.

The first Vice-Chancellor was Mr O. Pulla Reddi, a distinguished ICS officer whose last assignment in service was Defence Secretary to the Government of India. He served the University from 1964 to 1972 and laid a sound foundation. He was followed by Mr M. R. Rai (1972-1974). The next Vice-Chancellor was Dr C. Krishna Rao (1974-1978) and the present Vice-Chancellor is Dr J. Raghotham Reddi.

Recently two new departments, viz. Department of Forestry and Department of Fisheries, have been added to the faculties of Agriculture and Veterinary Science respectively.

'Earn while you learn' project for the students such as poultry farming, swine production, ice-cream making, vegetable growing, etc. are implemented to give the students practical work experience.

The University has entered into a collaborative agreement with the ICRISAT to train foreign students with special emphasis on dryland farming.

*Research.* The University has State-wise responsibilities for research in agriculture, animal husbandry, fisheries and farm forestry. It carries out its research activities through a network of 41 research sta-

tions, of which 35 are in agriculture, 3 in animal husbandry and 3 in fisheries. The Agricultural Research Institute and the Livestock Research Institute at Rajendranagar serve the State in general and Telangana Region in particular.

Besides its own research projects, the University collaborates with the ICAR by participating in the All-India Co-ordinated Research Projects in almost all the important crops and a few important aspects of agriculture relevant to the State. In all there are 137 State research projects schemes, 36 all-India co-ordinated research projects, and two other research projects in operation in the University.

The research activities of the University are problem-oriented with a multi-disciplinary approach for the solution of the problems of agriculture in the State. Research is therefore directed towards crop improvement, development of practices conducive for higher production, formulation of effective and economic plant-protection measures, maintenance of soil health and fertility, development of improved implements, development of dry-farming technology, improvement of livestock and forage crops, fish culture and farm forestry. The University has also established a research centre in a tribal area to develop technology suited to the socio-economic conditions of the tribals.

*Achievements.* The APAU has evolved and released 52 crop varieties so far. These include 12 in rice, 2 in *jowar,* 4 in *bajra,* 2 in *ragi,* 2 in maize, 1 in *korra,* one in *variga,* 5 in pulses, 1 each in groundnut, sesamum and safflower, 4 in sugarcane, 7 in cotton, 2 in chillies, 2 in guava, and 1 each in mango, betelvine, bougainvillaea and sannhemp.

In the cattle-improvement programme, cross-breeding of 'Ongole' with exotic breeds like 'Jersey', 'Brown Swiss' and 'Holstein-Friesian' has resulted in improved milk yield. Efforts are being made to stabilize the cross-breds.

Improved growth rates and feed efficiency were observed in cross-bred 'Nellore' and 'Mandya' sheep, crossed with 'Suffolk' and 'Dorset' rams compared with the native ones.

Some promising strains of chicken evolved by the University are undergoing final testing. Male and female lines are being identified to produce a commercial cross for releasing to the poultry keepers.

Research in forage crops is in progress to identify high-yielding varieties of grasses suitable for agro-climatic regions of the State. Fodder-seed production on commercial scale has also been taken up.

Research work on brackish-water fisheries, air-breathing fishes

and fresh-water prawns is being carried on. The aim of research work on brackish-water fishes is to study the rearing and breeding of marine fishes like mullets, chanos etc., and to evolve methods to increase their production. The programme for air-breathing fishes envisages development and standardization of techniques to culture them in unutilized, derelict and shallow waters. Work on fresh-water prawns is in progress to save juvenile prawns from destruction, and their culture in confined waters.

UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE (1965)

The University of Agricultural Sciences, Bangalore, was established under the Mysore Legislative Act 22 of 1963. With the transfer of Colleges of Agriculture at Hebbal and Dharwar and the Veterinary College, Hebbal, along with 34 research stations, it started functioning from 1 October 1965. The Marine Products Processing Centre, Mangalore, was transferred to it later. Most of the research organizations of the State Government have been transferred to the University along with 1 215 ha of land in the experimental stations.

*Contributions of Vice-chancellors.* The contributions of the two successive Vice-Chancellors, Dr K. C. Naik and Dr H. R. Arakeri, towards the establishment and development of the University are outstanding. Dr Naik served as the first Vice-Chancellor for three successive terms between 1964 and 1973. He was responsible for the framing of the statutes of the University. He initiated several innovative measures in teaching, research, extension and administration, and provided a sound base to the institution.

The University witnessed unprecedented growth since Dr Arakeri took over as Vice-Chancellor in 1973. Several new programmes like B. Sc. (Hort.), B. H. Sc. and B. Sc. (Agricultural Marketing and Co-operation), besides postgraduate instruction in Seed Technology and undergraduate teaching in Forestry and Sericulture, were initiated. The University established fruitful collaborative arrangement with the ICAR and other institutions in the area of teaching, research and extension. Administration was decentralized.

*Teaching.* When the University started, there were degree programmes only in Agriculture and Veterinary Sciences with traditional pattern of external examination-oriented course of instruction. Immediately after taking over, there was a shift to trimester internal-evaluation system. New undergraduate programmes leading to degree in Horticulture at Hebbal, Fishery Science at Mangalore, Home Science at Dharwar and Agricultural Marketing and Co-operation at Hebbal

were started. There is also a post-secondary programme offering Diploma in Agricultural Engineering at Raichur since 1969. Besides these, there are training programmes in Bakery for professionals and post-graduate Diploma programmes in Crop Production and Poultry Production for the benefit of agricultural and veterinary graduates who wish to go into practical business in these areas. Degree programmes in Forestry and Agricultural Engineering were started. Establishment of an Institute for Agriculture Administration and Management is also proposed.

At the inception of the University, steps were taken to start M. Sc., M. V. Sc. and Ph. D. programmes to provide advanced training in specialized areas in agriculture and veterinary sciences. Instructional programmes leading to M. Sc. and Ph. D. degrees are available in Agronomy, Agricultural Botany (Plant Breeding and Genetics), Crop Physiology, Entomology, Plant Pathology, Soil Science and Agricultural Microbiology. Besides, M.Sc. programme in Biochemistry and Statistics and Soil and Water Management Engineering are also provided. M. V. Sc. programme in Veterinary Anatomy. Veterinary Physiology, Veterinary Microbiology, Veterinary Pathology, Gynaecology and Obstetrics, Animal Genetics and Breeding, Animal Nutrition, Veterinary Medicine, Veterinary Parasitology, Veterinary Pharmacology and Veterinary Surgery are offered. Facilities for Ph. D. degree programme in Veterinary Microbiology and Veterinary Pathology also exist. Master's degree programme in Fish Production and Management and Industrial Fishery Technology are in operation at the Fisheries College, Mangalore. M. Sc. programmes in Dairy Chemistry and Technology and Dairy Microbiology are being started at Bangalore. The faculty strength in 1975-76 was 661, and the number of students on rolls was 3 600.

*Research.* The research set-up has been reorganized on the basis of agro-climatic conditions into 5 regions with well-equipped stations, located at Dharwar, Raichur, Mandya and Mudigere with Hebbal as the main station. These regional stations serve the specific needs of areas where they are located. The work on *jowar* and cotton receives main emphasis at Dharwar, whereas at Raichur in the Tungabhadra Project-Command Area the accent is on problems of irrigated crops. The problems of sugarcane and rice receive attention at Mandya, whereas at Mudigere emphasis is on plantation crops. The 39 medium research stations spread over the State work as adjuncts to the regional stations.

During the last 13 years over 60 new crop varieties have been evolved and released for cultivation. These have found favour with the far-

mers and their adoption has contributed in a big way towards the all-round agricultural upsurge in evidence in the State in the past 6 to 8 years. Similarly, attention has been paid to soil improvement, plant protection and augmentation of animal resources, including poultry and fisheries. Inter-specific hybrid cotton 'Varalaxmi', a cross between *Gossypium hirsutum* and *G. barbadense* parents, deserves special mention. It has a yield potential of 50 q/ha under irrigation with a long staple fibre spinning up to 80 counts. The variety is cultivated in over 50 000 ha.

*Extension.* The University imparts training to extension personnel of the State Development Departments like Agriculture, Horticulture, Animal Husbandry and Veterinary Services and Fisheries. Programmes are organized at State, district and field level. The training programmes for the farmers are conducted through field days at the research stations, at the demonstration plots and at the Farmers' Training Institute.

# CHAPTER 29

# AGRICULTURAL UNIVERSITIES

## Phase II : 1969-71

THERE are four agricultural universities in Maharashtra, viz. Mahatma Phule Krishi Vidyapeeth, Rahuri; Punjabrao Krishi Vidyapeeth, Akola; Marathwada Agricultural University, Parbhani; and Konkan Krishi Vidyapeeth, Dapoli. This proliferation has taken place to meet regional needs. Another university in Phase II is Assam Agricultural University, Jorhat. On account of reorganization of Punjab, the PAU shed its campus at Hissar which developed into an independent university in 1970. Tamil Nadu followed by establishing a university at Coimbatore in 1971. Bihar came next and established a university at Patna in 1971.

The four agricultural universities of Mararashtra at Rahuri, Akola, Parbhani and Dapoli are described below.

### MAHATMA PHULE KRISHI VIDYAPEETH, RAHURI

Mahatma Phule Krishi Vidyapeeth started functioning from 20 October 1969. The University with its central campus at Rahuri has jurisdiction over nine districts of western Maharashtra. The area is distinctly divided into a high rainfall zone adjoining Western Ghat, assured rainfall zone, and drought-prone area.

The first Vice-Chancellor was Mr H. G. Patil whose term ended in 1971. He was succeeded by Dr M. S. Pawar (1971-1977). Dr A. B. Joshi took over from Dr Pawar in 1977.

The principal landmarks in the course of development of this University and its main achievements are given below.

*Education.* The undergraduate instructional programme in agriculture is carried out at the three constituent colleges of Pune, Dhule and Kolhapur, and in agricultural engineering in the College of Agricultural Engineering, located at the central campus. The postgraduate instruction in agriculture is imparted at the Postgraduate School at Rahuri. With the formation of this University, a course credit and an internal evaluation system of instruction was introduced at the undergraduate level in 1968 in the first instance, and was extended to the Postgraduate School in the subsequent year. The trimester system adopted initially has subsequently been changed to semester system. The annual enrolment in the Agricultural College is 480, and 20 students are admit-

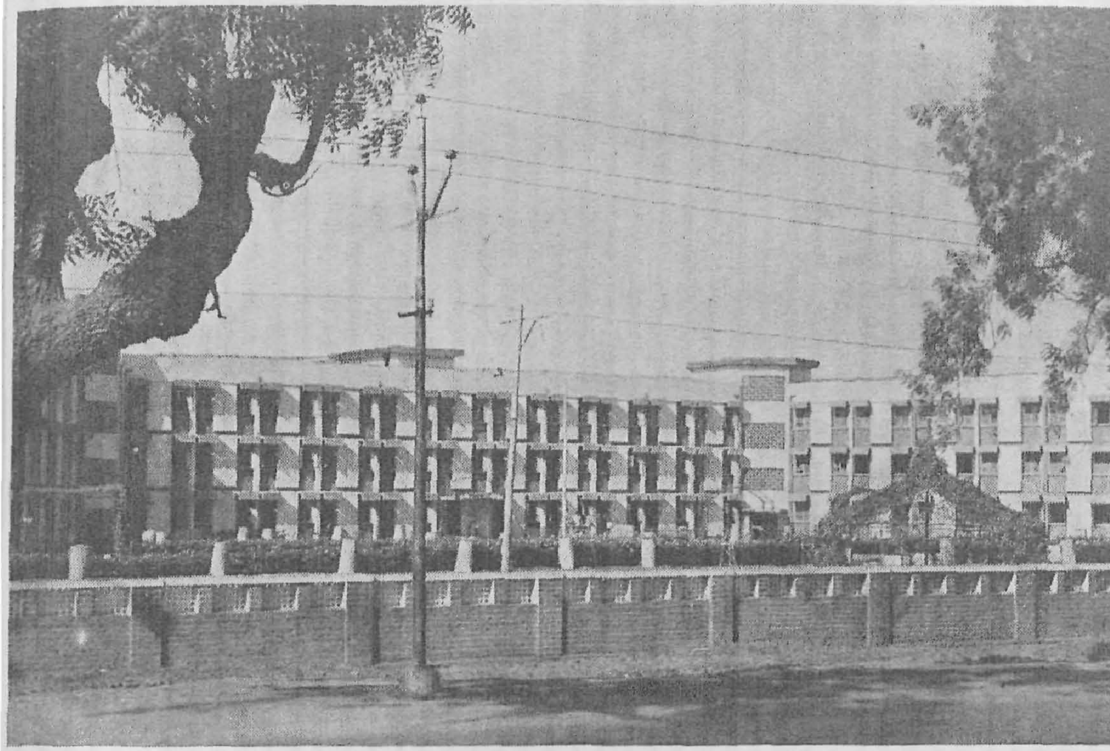


Fig. 41. Mahatma Phule Krishi Vidyapeeth, Rahuri — hostel building

Fig. 42. Punjabrao Krishi Vidyapeeth, Akola

Fig. 43. Marathwada Agricultural University, Parbhani

Fig. 44. Haryana Agricultural University, Hissar — main building

ted in the Agricultural Engineering College. The Postgraduate School admits about 90 students including in-service candidates for M. Sc. (Agric.) in 12 disciplines.

Initially the B.Sc. (Agric.) degree programme was of 4 years after S.S.C., but with the introduction of new pattern of education the degree programme has been extended to 3½ years after the 12th standard. The last semester has been reserved for internship. A provision of work experience has also been made in different disciplines throughout the duration of the degree programme. Ten credits are allotted to this programme. The B. Tech. (Agricultural Engineering) degree course is of 4 years duration. Emphasis is given to make the undergraduate training practical oriented. The postgraduate degree programme consists of a course credit and a research thesis.

There are nine agricultural schools in the jurisdiction of this University, one per district with a total admission capacity of 450 students per annum. Two-year diploma course is offered to the students. Most of the students come from the farming community.

*Research.* The University has five main research stations at Rahuri, Sholapur (dry farming), Niphad (wheat), Jalgaon (oilseeds), and Padegaon (sugarcane), and 19 substations spread over the nine districts under its jurisdiction. In addition, research work is also in progress at all the constituent college campuses. The research activities of the University are strengthened considerably by participation in 36 all-India co-ordinated research projects, sponsored by the ICAR and two projects sponsored by the Government of India. The research activities are aimed mainly at improvement of food crops, oilseeds, pulses, sugarcane and cotton. Emphasis is given on dry farming, since much of the area in the jurisdiction of the University comes under rainfed farming and a large portion of it is drought prone.

*Dry farming.* A dry-farming technology suitable for rainfed areas and dry-farming situations in the State of Maharashtra has been developed , which includes sowing of *rabi jowar* in the first fortnight of September with carbofuran treatment that gives about 50% more yield than the sowing in early October. It helps in giving about 100% more yield. In addition, to a dry-farming technology, cropping patterns to suit aberrant weatherhave also been developed and recommended to the cultivators.

*Extension education.* The 'Scheme for development of extension education', in operation at the central campus and at the three constituent colleges, undertakes activities like training programme for extension

personnel and farmers. Besides, mini-kit trials conducted by the Zila Parishads are jointly supervised by the staff of the Department of Agriculture and the University. Every year training is imparted to the staff of the development departments like Agriculture, Animal Husbandry and Dairying, and Forestry, in improved technology. The training classes for 2 days to 3 months are arranged. Short-term training programme of 2 days to 7 days for farmers in improved agricultural practices and improving skills are also arranged. Every year 420 classes are arranged, wherein about 40 000 persons are trained. Seminars on specialized topics like dry farming, cotton, sugarcane, grape cultivation or special problems associated with them are also arranged.

PUNJABRAO KRISHI VIDYAPEETH, AKOLA

In pursuance of the Punjabrao Agricultural University (Krishi Vidyapeeth) Act, 1968, this University started functioning with effect from 20 October 1969, and has jurisdiction over Nagpur revenue division comprising eight districts of Maharashtra State. It is named after late Dr Punjabrao Deshmukh who was Minister of Agriculture, Government of India, who founded the Bharat Krishak Samaj.

The first Vice-Chancellor was Mr L. N. Bongirwar (1969-1972). He was followed by Mr N. Gopalakrishna (1972-1978). The present Vice-Chancellor is Dr A. N. Chaugule, a well-known agronomist.

*Education.* Agricultural education in this University is patterned on two-tier system, viz. (*i*) higher agricultural education consisting of graduate and postgraduate instruction programme, (*ii*) and lower agricultural education programme at the Agricultural Schools and the Gramsevak Training Centres. This University has adopted course credit and internal evaluation system of education by apportioning the academic year into two semesters coinciding with the two major agricultural seasons of the year.

So far this University has established the faculties of Agriculture, Veterinary Science and Agricultural Engineering, and Departments of Forestry and Inland Fisheries.

The University has following colleges under it, viz. College of Agriculture, Akola; College of Agriculture, Nagpur; Nagpur Veterinary College, Nagpur; College of Agricultural Engineering, Akola; Postgraduate Institute, Akola; Anand Niketan College of Agriculture, Warora, and Shri Shivaji College of Agriculture, Amravati.

*Research.* Only 18 research substations were taken over by the University from the State Department of Agriculture in 1969, with the result that research activities could not be broad-based. Still the Uni-

versity initiated applied research in several aspects of agriculture and allied subjects with the help of 21 research schemes financed by the ICAR. The evolution and selection of high-yielding and promising varieties of cotton, *jowar*, wheat, rice and oilseeds, development of agronomic and plant-protection schedules for cultivation of crops and control of pests and diseases of crops, investigations of crop-production practices for dryland agriculture, and fabrication of bullock-drawn and other implements and appliances are some of the achievements.

## MARATHWADA AGRICULTURAL UNIVERSITY, PARBHANI

The Marathwada Agricultural University was established on 18 May 1972 at the Central Campus, Parbhani, to meet the agricultural education needs of Marathwada. The total geographical area of this region is 64 525 km$^2$. Marathwada is a rolling plane. There are two major hill ranges—Satmala in the north and Balaghat in the south. Godavari, Purna, Dudhana, Painganga and Manjara are the rivers flowing through this region.

The Marathwada is covered with black cotton soil derived from Deccan trap volcanic rock, which varies greatly in texture and depth.

In the Marathwada Agricultural University there are four faculties : Agriculture, Veterinary Sciences, Agricultural Technology and Home Science. Lower education covers two Gramsevak Training Centres and five Agricultural Schools. There are in all 12 agricultural research stations. Main centres for research for cotton, sorghum, *bajra* and pulses for the entire Maharashtra State are located in this University.

Mr L. S. Sundara Rajan was the first Vice-Chancellor (1972-1974). The present Vice-Chancellor is Dr V. S. Khuspe.

*Education.* The College of Agriculture, Parbhani, was started in 1956 with admission capacity of 64, later raised to 210. The trimester system was introduced in 1968-69, and since 1975 the instruction has been switched over to semester system. So far 1981 students got B. Sc. (Agric.) degree from this college.

Postgraduate teaching leading to M. Sc. (Agric.) is imparted in nine disciplines since 1970. Every year 72 students are admitted. Facilities are also provided for in-service graduates for postgraduation. So far 341 students have secured M. Sc. (Agric.) degree. Ph. D. courses have been started in nine disciplines.

College of Veterinary and Animal Sciences was established on 18 May 1972 with admission of 25 students, later raised to 58.

The College of Agricultural Technology was established in June

1976 to impart education with emphasis on post-harvest technology, food processing, and utilization of by-products and wastes. The college offers 4-year degree course leading to B. Tech. degree with specialization in Food Science and Technology. Thirty-two students are admitted every year.

The College of Home Science was established in June 1976. It offers 3-year degree course leading to B. Sc. (Home Science). The total intake capacity is 32 students every year.

KONKAN KRISHI VIDYAPEETH, DAPOLI

The Konkan Krishi Vidyapeeth was established at Dapoli by the Government of Maharashtra on 18 May 1972 as per the Maharashtra Act XVIII of 1972 (Konkan Agricultural University Act, 1972). The objective of establishing this University was to tackle agricultural problems of the Konkan region for helping the rural people to increase agricultural production including livestock and fisheries. The region comprises Thane, Kulaba, Ratnagiri and Greater Bombay districts.

Dr M. S. Pawar was the first Vice-Chancellor (1972-1974). He was followed by Mr S. V. Chavan (1974-1977). The present Vice-Chancellor is Dr P. N. Salvi.

The KKV has three faculties, viz. Agriculture, Veterinary Science and Fisheries. The Faculty of Agriculture and the Vice-Chancellor's office are being developed at Dapoli. The Central Farm of the Vidyapeeth is being developed at Wakawali, situated 14 km from Dapoli. The Faculties of Veterinary Science and Fisheries are being developed at Aarey (Bombay) and Ratnagiri respectively.

*Education*. Facilities for undergraduate, postgraduate and lower education in agriculture are provided at the College of Agriculture, Dapoli, and Agricultural Schools, Roha (District Kulaba) and Lanja (District Ratnagiri). Sixty-four students are admitted to the undergraduate course every year. Twenty-two students are admitted to M. Sc. (Agric.) degree course in eight disciplines in the Agriculture Faculty.

Instruction in Veterinary Science are imparted at the Bombay Veterinary College, Bombay, at the undergraduate and postgraduate levels. Seventy-five students are admitted to the first year of the B. V.Sc. & A. H. degree course and 26 students to the M. V. Sc. course annually. Postgraduate instruction leading to Ph. D. degree is also imparted at this college.

The Faculty of Fisheries comprises two Marine Biological Research Stations. One is located at Bombay and the other at Ratnagiri. Ins-

truction leading to M. Sc. and Ph. D. degrees in Fisheries is offered at these research stations.

*Research.* Research is carried out on rice, mango, cashewnut, coconut and fodder crops.

Trials on raising of *tasar* silkworms on *ain* trees are in progress. Disease-free layings of *Antheraea mylitta* species were used.

In the Konkan, ingress of sea water has rendered about 60 000 ha of land saline and uncultivable. The saline land (*khar* land) is a problem in agricultural production. The University's *khar* land research station at Panvel has undertaken research to reclaim these soils and recommend suitable crops for them. It has successfully developed a technique for reclaiming these *khar* lands, and has evolved 'Bhura Rata', 'Kala Rata', 'NK 47-22' and 'SR-3-9' rice varieties suitable for these soils.

*Extension education.* The Vidyapeeth trains the extension personnel in improved agricultural production technology before *kharif* and *rabi* seasons.

Seeds of high-yielding varieties of rice, *nagli* and pulses are distributed to farmers by the University every year. Also, quality grafts of mango, and seedlings of 'Tall'×'Dwarf' coconuts, seedless lemon, *kokam*, jackfruit, blackpepper, cocoa and papaya are supplied to the farmers.

## ASSAM AGRICULTURAL UNIVERSITY, JORHAT (1969)

The Assam Agricultural University was established on 1 April 1969 under the Assam Agricultural University Act, 1968. The University started functioning with the Assam Agricultural College and the Assam Veterinary College as its constituents.

The jurisdiction of the University extends to the entire State of Assam. It also caters to the needs of the neighbouring States and Union Territories of the North-East region.

The first Vice-Chancellor of the University was Dr S. R. Barooah, who took charge on 19 March 1969. He relinquished office on 11 October 1971. Late Dr R. N. Hazarika, the then Dean of the Faculty of Veterinary Science, officiated till the assumption of the office by Dr L. S. Negi as Vice-Chancellor on 1 June 1972. After completion of his 5-year term on 1 June 1977, Dr Negi was succeeded by late Mr P. S. Majumdar, who joined on 11 June 1977. Mr Majumdar proceeded on leave on medical grounds within a year and died on 4 January 1979. Dr M. N. Bora, the Dean, Faculty of Agriculture, is now the acting

Vice-Chancellor.

The University has two campuses : the Jorhat Campus—the administrative headquarters of the University—and the Khanapara Campus, where the College of Veterinary Science is located.

*Education.* The University has three faculties : the Faculty of Agriculture (which includes the discipline of Basic Sciences also), Faculty of Veterinary Science and the Faculty of Home Science. The Faculty of Agriculture and Veterinary Science were constituted with the incorporation of the erstwhileAssam Agriculture College and the Assam Veterinary College of the Government of Assam in 1969. These two colleges were established under the Post-War Reconstruction Programme in 1948.

The College of Home Science was established in 1973. It started functioning from the academic session 1973-74 with 26 students on its rolls.

The Colleges of Agriculture, Veterinary Science and Home Science offer undergraduate courses, leading to B. Sc. (Agric.), B. V. Sc. and B.Sc. (Home Science) degrees respectively. Facilities for postgraduate teaching are available in eight disciplines each in the College of Agriculture. M. Sc. (Agric.) course was first introduced in Agronomy in 1960, then in Agricultural Chemistry, Entomology and Plant Pathology in 1965 and later on in Genetics and Plant Breeding, Agricultural Economics, Horticulture and Tea Husbandry and Technology in 1972.

In the College of Veterinary Science, postgraduate course leading to M. V. Sc. degree was introduced in 1968 in five disciplines, viz. Medicine, Animal Nutrition, Animal Production and Management, Gynaecology and Physiology. In 1972, M. V. Sc. course was introduced in two more disciplines, Pathology and Parasitology, and in 1973 in Surgery.

The College of Home Science offers undergraduate course in the following disciplines : Food and Nutrition, Textile and Clothing, Child Development and Family Relation, Home Management and Extension Education.

The College of Agriculture offers need-based and employment-oriented course in Tea Husbandry and Technology both at the undergraduate and postgraduate levels. The objective of this course is to provide to the tea industry technically qualified management personnel and tea technologists. This course has attracted students from other States of India and also from East Africa and the Middle East.

The undergraduate education in the University started with an an-

nual intake capacity of 80 in the College of Agriculture, and 60 in the College of Veterinary Science. The intake capacity of both the colleges has since been gradually raised, and the present capacity stands at 100 in the College of Agriculture, and 90 in the College of Veterinary Science. The intake capacity of the postgraduate departments is limited to 7 in each department in both the faculties.

*Research.* The Government of Assam transferred six research schemes and the All-India Co-ordinated Rice Improvement Project financed by the ICAR to the University in 1969. During the 3 years that followed, the ICAR sanctioned six co-ordinated projects relating to agriculture and three to animal sciences. By 1973 the State Government transferred to the University all the remaining research schemes, including three co-ordinated research schemes. The ICAR sanctioned three *ad-hoc* research schemes on animal sciences during that year. The University established a regional station for research on citrus fruits in 1976 and three regional stations.

The research programmes are confined to identification and varietal improvement of strains of crops and animals, evolution of suitable agronomic practices and water-management principles, control of pests and diseases of crops and animals, and to undertake studies on the economics of multiple cropping.

*IDA education project.* The AAU is a recipient of financial assistance from the International Development Association under its Education Project. Under this agreement the IDA provides financial support amounting to over Rs 50 million to the AAU for its educational infrastructure, and the faculty staff over a period of 5 years. The principal components of the Project include : campus development and building, equipment, books and furniture, fellowships for faculty-staff development and advisory service.

The University has responsibility of the overall economic development of the north-eastern region. To meet the increasing needs and keeping in view the potential of the region, the University envisages creation of facilities for higher studies in the fields of fisheries, sericulture and farm forestry. It also contemplates establishment of a College of Agricultural Engineering and Technology to deal with the problems of soil and water conservation and management.

### HARYANA AGRICULTURAL UNIVERSITY, HISSAR (1970)

The Haryana Agricultural University came into existence on 2 February 1970 when the PAU was bifurcated by an ordinance of the

President of India which was later replaced by the Haryana and Punjab Agricultural Universities Act of 1970. At its inception, the HAU inherited an area of 2 244.63 ha on which, beside the farm and experimental plots, it had the Colleges of Veterinary Medicine, Animal Science, Agriculture, and Basic Sciences and Humanities. Besides these, there was also a Teachers' Home, five Hostels and 358 residential houses.

The University during the 8 years of its existence has developed into one of the best planned campuses in India. Without exaggeration it is the most impressive campus of all agricultural universities in the country. Planning has been done in such a way that even for years to come there is ample space for extending facilities for research, education and healthy community life.

The first phase was that of construction of buildings. Soon after its formation, the then Vice-Chancellor, late Mr A. L. Fletcher, a retired ICS officer, gave top priority to campus development. One after another beautiful buildings rose on the campus. The campus now has a Shopping Centre, post office and banking facilities, a hospital and a school, children's parks and a club for campus children, a Community Centre, a Faculty House, Faculty Club and a Farmers' Hostel, flats for teachers and residential houses for different categories of employees. Other buildings which were completed in this phase are the Gandhi Bhawan, which is the nucleus of extension activities, the College of Home Science and the College of Basic Sciences and Humanities, Giri Centre Complex and the Nehru Library.

Building activity extended to outstations also. The Krishi Gyan Kendras have their own buildings at district headquarters.

*Research.* The university carries out problem-oriented research in different disciplines of agriculture, veterinary, animal sciences and basic sciences for solving problems faced by the farmers, livestock owners and agro-industries. The University has established four Animal Disease Investigation Laboratories also.

*Vice-Chancellors.* Mr A. L. Fletcher, ICS (retired), was the first Vice-Chancellor. A man of vision and foresight, he provided a sound base to the University. His ambition was to make HAU the best university in India. Much of the construction work was completed by Mr Fletcher and the rest during the tenure of Mr N. N. Kashyap, ICS (retired), who was the Vice-Chancellor from 6 February 1974 to 30 September 1977.

In October 1977 Dr P. S. Lamba became the Vice-Chancellor.

He gave a fillip to research, teaching and extension activities. Posts lying vacant for years were filled up. Working of the Departments was streamlined and research activities stepped up. The rotation of Heads was put into practice and amenities were provided to the staff and students. Owing to his rural background, Dr P. S. Lamba is well acquainted with the problems of the farmers in the State. He has taken keen interest in the problem-oriented research in the disciplines of Agriculture, Veterinary and Animal Sciences and Home Science.

Keeping in view the problems of the State, research on dryland agriculture has been strengthened. A project for research on cereals, pulses and oilseeds in the dry areas of the State with the assistance of World Bank has been taken up.

Haryana is famous for its cattle. Steps have been taken to improve the 'Hariana' breed. Cross-bred animals are being popularized for increasing milk production. Arrangements are being made to supply these animals to marginal and submarginal farmers in the villages adopted under the Operational Research Project. Research in Veterinary Sciences has also been stepped up.

TAMIL NADU AGRICULTURAL UNIVERSITY, COIMBATORE (1971)

The Tamil Nadu Agricultural University was established in 1971 by an Act of the State Government and entrusted with agricultural research, education and extension education needs of the State. The colleges at Coimbatore and Madurai along with the facilities and research centres in Coimbatore and Madurai districts were handed over to the TNAU as its constituents.

Dr G. Rangaswami became its first Vice-Chancellor. He organized the academic programmes and framed the regulations and statutes. He also developed a Master Plan for the development of the University. All the teaching, research and extension-education work, which were looked after by separate persons, were restructured in terms of departments and separate faculties. The Faculty of Basic Sciences and Humanities was started in 1972, and the College of Agricultural Engineering was established in 1976 in Coimbatore. The present Vice-Chancellor, Mr T. A. Venkataraman, joined on 30 August 1978.

The period 1971-1975 witnessed a phenomenal growth in research and extension education in the University set up. The Directorate of Research was established, field-oriented, time-based research projects were identified and the Heads of Departments were made responsible for integrating the work of teaching, research and ex-

tension education in a fruitful manner. In the field of extension education, a well-defined Directorate of Extension Education with Farmers' Training Centres, a communication centre and a printing press were organized. The Research Council and the Extension Education Council were established, paving the way for a two-way channel for dissemination of extension information and for receiving a continuous feed-back for field-oriented research. In teaching, the University switched over from the annual system to trimester system of teaching, and undertook the orientation of the teachers through regular teaching seminars; courses and syllabi were suitably formulated. The Department of Agricultural Economics strengthened its teaching and research programmes under a Ford Foundation grant.

In 1976 the Madras Veterinary College along with its research units was transferred to the University, and this marked the integration of Veterinary and Animal Sciences in the agricultural education system in the State. Since 1976 the University offers four undergraduate programmes, viz. B. Sc. (Agric.), B. Sc. (Hort.), B. E. (Agric.) and B.V.Sc. degree programmes and M.Sc. and Ph.D. programmes in all the agricultural subjects. In 1977 a new degree programme in Fisheries (B. F. Sc.) was commenced. A separate College for Fisheries was established at Tuticorin in 1977 on a 50-ha site on the sea-coast.

New courses at postgraduate level like Seed Technology, Environmental Biology, Agrostology and Soil and Water Conservation were started.

The research activities were finally related to the Master Plan drawn for the development of the TANU, which contemplated setting up of new research departments and stations in different agro-climatic regions of the State to carry out research on new cropping patterns, rainfed agriculture, mixed farming, horticulture, fisheries, forestry, soil and water management and animal sciences. Other landmarks of this period are the starting of two Krishi Vigyan Kendras, one in Pondicherry and the other in Trichirapally.

Now there are 17 research stations, research centres and 48 departments in the University, spread over four faculties. Recently 10 agricultural stations, seven research centres and four animal research stations were also transferred to the University by the State Government.

## RAJENDRA AGRICULTURAL UNIVERSITY, PATNA (1971)

The Rajendra Agricultural University started functioning from

1 February 1971 at the Bihar Veterinary College Campus, Patna, when the three Agricultural Colleges at Sabour, Kanke and Dholi, two Veterinary Colleges at Patna and Ranchi, four Regional Agricultural Research Institutes located at Patna, Dholi, Sabour and Kanke, and Sugarcane Research Institute, Pusa, besides a number of research schemes sponsored by the ICAR were transferred to the University by the State Government along with staff, budget and facilities. A Cattle Farm at Pusa and Animal Production Research Station, Birauli, were subsequent additions. In view of the unique possibility of agricultural development in the fertile planes of north Bihar, the State Government decided to locate the headquarters of the University at Dholi-Pusa Campus. In addition, Kanke (Ranchi) was designated as the main campus for Animal Husbandry and Veterinary Science for developing animal production in the plateau of Chhotanagpur.

Mr S. K. Chakravarty (1970-1973) was the first Vice-Chancellor. Dr D. P. Singh is the present Vice-Chancellor since January 1977.

*Education.* For developing a proper pattern of agriculture and animal husbandry education in the State, the University runs both undergraduate and postgraduate courses in its three agricultural and two veterinary colleges. Efforts are being made for need-based orientation of the course curricula, without affecting their quality and content, so that the University may be in a position to produce such graduates as are academically sound and professionally competent for self-employment. Due to proper integration of the tripartite activities of the University, e.g. education, research and extension education, it has been possible to attain higher standards in all of them.

The creation of the Faculty of Home Science is in itself a significant step in respect of female education in the State of Bihar. It has been decided to introduce teaching in this faculty from July 1979. Steps are also being taken for introducing courses in the Faculty of Basic Sciences and Humanities in the University.

The sanctioned strength of faculties in 1975-1976 was 177 and the number of students on roll about 800.

*Research.* Agricultural research is being done at Regional Agricultural Research Institutes of the University located at Sabour (Bhagalpur), Patna, Kanke (Ranchi) and Dholi (Muzaffarpur). Research stations also exist in the different parts of the State for work on specific situations and crops, e.g. Fruit Research Station at Chianki (Palamau), Irrigation Research Station, Bikramgung (Rohtas), Banana Research Station, Hajipur (Vaishali) and Jute Research Station, Katihar (Purnea)

etc. The Sugarcane Research Station located at Pusa devotes itself to researches on varied aspects of the sugarcane crop, supported by its zonal centres in the sugarcane factory areas of the State. Improved varieties of rice, wheat, barley, maize, *arhar*, *moong*, *urd*, gram, pea, sugarcane, oilseeds and sweet-potato have been evolved.

Research in respect of animal husbandry problems is carried out at the Animal Production Research Institute, Birauli (Samastipur), and the two veterinary colleges of the University at Patna and Kanke (Ranchi).

CHAPTER 30

# AGRICULTURAL UNIVERSITIES

## Phase III: 1972-78

FROM 1972 to 1978 six agricultural universities were started in the States of Kerala, Gujarat, West Bengal, Uttar Pradesh and Himachal Pradesh. In the following account, how they came into existence, in what stage of development they are, and what are their programmes of development, are described. They are yet in a formative stage and have to establish themselves.

### KERALA AGRICULTURAL UNIVERSITY, MANNUTHY (1972)

The Kerala Agricultural University came into existence under the Kerala Agricultural University Act, 1971. The university started functioning in February 1972 when the College of Agriculture, Vellayani, and the College of Veterinary and Animal Sciences, Mannuthy, along with 21 agricultural and animal sciences research stations were transferred to it.

The main campus of the University is at Vellanikkara in Madakkathara Panchayat, 9 km east of Trichur town. Till the shifting of the University office to Vellanikkara in March 1978, the headquarters was temporarily located in the campus of the College of Veterinary and Animal Sciences, Mannuthy. The area of the main campus is 848 ha. The second campus of the University, the College of Agriculture, Vellayani, comprises an area of 243 ha.

Mr N. Chandrabhanu, as IAS officer, was appointed the first Vice-Chancellor in 1971 and he continued for two years. Dr C. M. Jacob was the Vice-Chancellor from 1973 to 1975. The present Vice-Chancellor is Mr N. Kaleswaran.

Need was felt for strengthening horticultural education and research, as in Kerala nearly two-thirds of the cultivated area is under horticultural and plantation crops. Hence a Horticultural College was established in October 1972 with an admission strength of 20 students for the B. Sc. (Hort.) degree course.

During 1973-74 the Agronomic Research Station, Chalakudy, and Rice Research Station, Vyttila, till then held by the Department of Agriculture, were transferred to the University. In 1975 a farm was established in Thiruvalla for research on sugarcane.

The Rural Institute, Tavanur, was taken over by the University in

1975. It is being developed as an institute of agricultural technology and has been renamed the Institute of Agricultural Technology.

A goat farm, a duck farm and a buffaloe farm have been started in the Veterinary College campus.

The administrative hierarchy of the University begins with the Governor of Kerala as Chancellor. The Minister for Agriculture is the Pro-Chancellor. The Vice-Chancellor is the principal executive and academic officer of the University.

*Research.* The Central Rice Research Station, Pattambi, is doing pioneering work in rice cultivation in Kerala and has released three high-yielding rice strains in 1974.

The Coconut Research Station, Nileshwar, has evolved four new hybrids which recorded increased yield of 15% of copra and 10% of nuts over the popular 'Tall' × Dwarf' hybrid.

The Lemongrass Research Station, Odakkali, has evolved a new high-yielding variety of lemongrass, viz. 'OD 19', which gives 200% increased oil yield over the local variety and has higher citral content.

Studies carried out with tapioca leaves, starch waste, silk cotton seed and cake, rubber seed and cake and fruit waste have revealed that tapioca leaf-meal can be profitably incorporated in cattle rations, and tapioca starch waste can replace such costly ingredients as maize, and tapioca chips can be used in the feed for cattle and pigs.

A major breakthrough in goat breeding for higher milk yield has been achieved by crossing the indigenous 'Malabari' breed with the 'Saanen' and 'Alpine' breeds from Switzerland.

*Extension education.* The main strength of the KAU extension education is the close rapport established with the State extension departments. The University organizes in-service training programmes for the staff of the State Departments. It provides the services of scientists for technical support to the farmers' training campus organized by the departments. The University specialists help the extension staff to diagnose the causes and recommend remedial measures.

## GUJARAT AGRICULTURAL UNIVERSITY, DANTIWADA, DISTRICT BANASKANTHA (1972)

The Gujarat Agricultural University Act was passed by the State Legislature in 1969, and the University was established in 1972. Mr V. R. Mehta was appointed Vice-Chancellor of the University on 1 February 1972 and he continued till January 1978. Mr Ishwarbhai J. Patel is the present Vice-Chancellor.

Teaching, research and extension education activities were transferred by the Agriculture and Animal Husbandry Departments of the State and the Institute of Agriculture, Anand, to the University on 1 June 1972. Thus the three agricultural colleges at Anand, Junagarh and Navsari, the College of Dairy Science and the Gujarat College of Veterinary Science and Animal Husbandry at Anand, four Gramsevak Training Centres, 13 agricultural schools, one home science school, one Bakery Training School, one Poultry Training Centre and the Bidi Tobacco Training Centre at Anand and also the Livestock Inspector Training Centre at Baroda came within the administrative control of the University. Research schemes totalling 55 and operating at 18 different centres were also transferred to it.

With the transfer of these institutions, the University acquired the character of a multi-campus institution with special problems of co-ordination. The University Act provides for the establishment of campuses and Junagarh was designated the first campus of the University.

Later on Anand and Navsari were also declared as campuses of the University. Thus the three principal centres where educational, reresearch and extension education activities were practised in Gujarat became the campuses of the University. A distinctive feature of the Gujarat Agricultural University Act is the provision of appointment by the Government of the Director for each campus for a period of 3 years. The appointee is a public worker.

The medium of instruction at the undergraduate level for agricultural graduates is Gujarati and for veterinary graduates English.

The main campus of the University will be set up at Dantiwada in the Banaskantha district of Gujarat State.

## BIDHAN CHANDRA KRISHI VISHWA VIDYALAYA, HARINGHATTA, DISTRICT NADIA (1974)

The Bidhan Chandra Krishi Vishwa Vidyalaya was instituted by an Ordinance of the Government of West Bengal (Ordinance X of 1974, later on replaced by Act XLIX of 1974) and has been functioning since September 1974. Professor S. D. Chattopadhyay was the first Vice-Chancellor (1974-1978). The present Vice-Chancellor is Dr M. M. Chakravarti.

To fulfil the objectives and to carry out its functions in an effective manner, the University formulated a Master Plan, indicating the broad approaches for development on a long-term basis as well as the imme-

diate development programme and its requirement. Keeping this in view a development plan for education, research and extension education has been prepared.

*Education.* The University trains the technical manpower at all levels and in different branches of agricultural sciences to meet the needs of the development departments of the State, the research establishments of the Centre, State, university and similar other organizations, vocational education institutions, nationalized banks and private-sector agencies. To fulfil this, steps are required to be taken to develop different branches of agricultural education with broader outlook and well thought-out balanced programmes of development. At present, in this University there are two faculties, viz. the Faculty of Agriculture and the Faculty of Veterinary and Animal Sciences.

The Faculty of Agriculture has the following departments offering courses in their specialized disciplines, at the undergraduate and postgraduate levels, viz. Agronomy, Agricultural Chemistry and Soil Science, Agricultural Economics, Agricultural Engineering, Agricultural Entomology, Agricultural Extension, Agricultural Statistics, Genetics and Plant Breeding, Horticulture and Plant Pathology.

The Department of Agricultural Engineering offers a postgraduate degree in Soil and Water Conservation in collaboration with the Department of Agronomy and Agricultural Chemistry and Soil Science. The Department of Agricultural Statistics has no postgraduate degree programme of its own, but offers a number of courses on agricultural statistics to the postgraduate students belonging to the other Departments, in addition to compulsory and elective courses offered to the undergraduate students.

The Faculty since its inception under the University of Kalyani has so far produced 1 700 graduate B.Sc. (Agric.), 500 postgraduate M. Sc. (Agric.) and about 70 Ph. D. in agriculture. The intake capacity for the undergraduate programme is 130 per academic year and for the postgraduate programme about 10-15 in each department.

The Faculty of Veterinary and Animal Sciences now prepares students for B. V. Sc. & A. H., M. V. Sc. and Ph. D. degrees in Veterinary and Animal Sciences and has the following Departments, viz. Animal Physiology, Veterinary Anatomy, Veterinary Pathology and Preventive Veterinary Medicine, Veterinary Clinical Medicine and Pharmacology, Veterinary Gynaecology ans Obstetrics, Veterinary Surgery, Animal Nutrition, Animal Production and Management, Veterinary Bacteriology, Veterinary Parasitology and Department of Clinics.

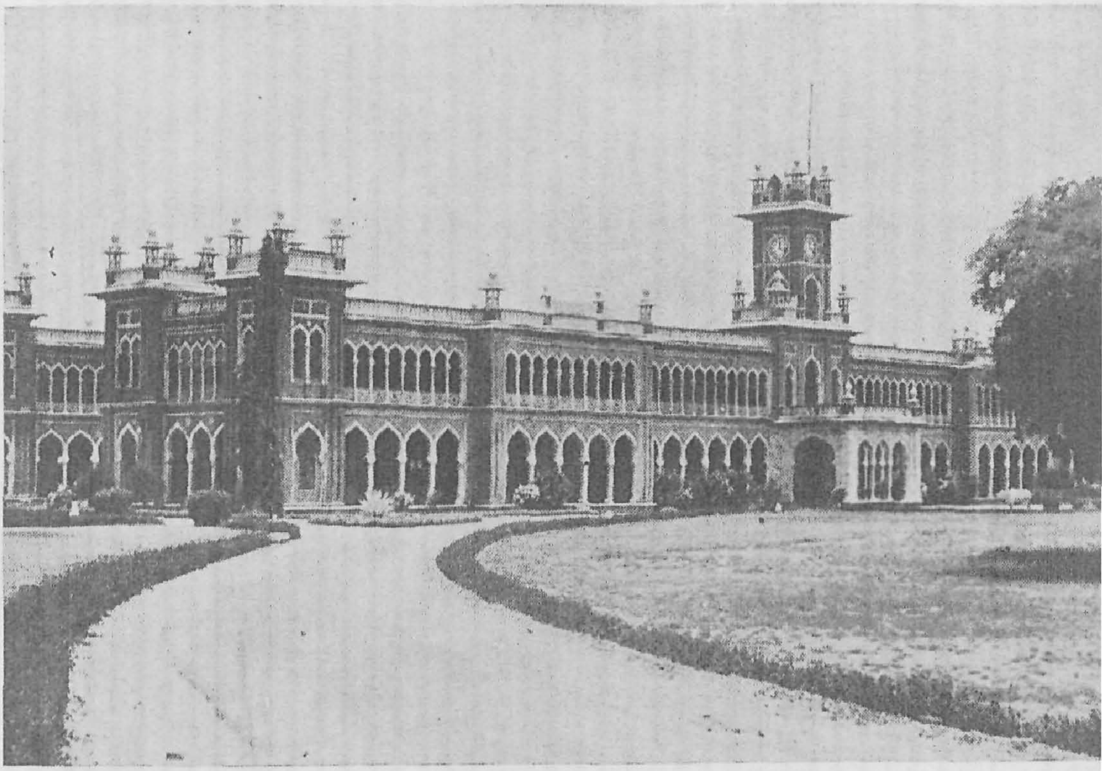


Fig. 45. Tamil Nadu Agricultural University, Coimbatore

Fig. 46. New College building at the S. N. Stokes Horticultural Complex, Nauni, Himachal Pradesh

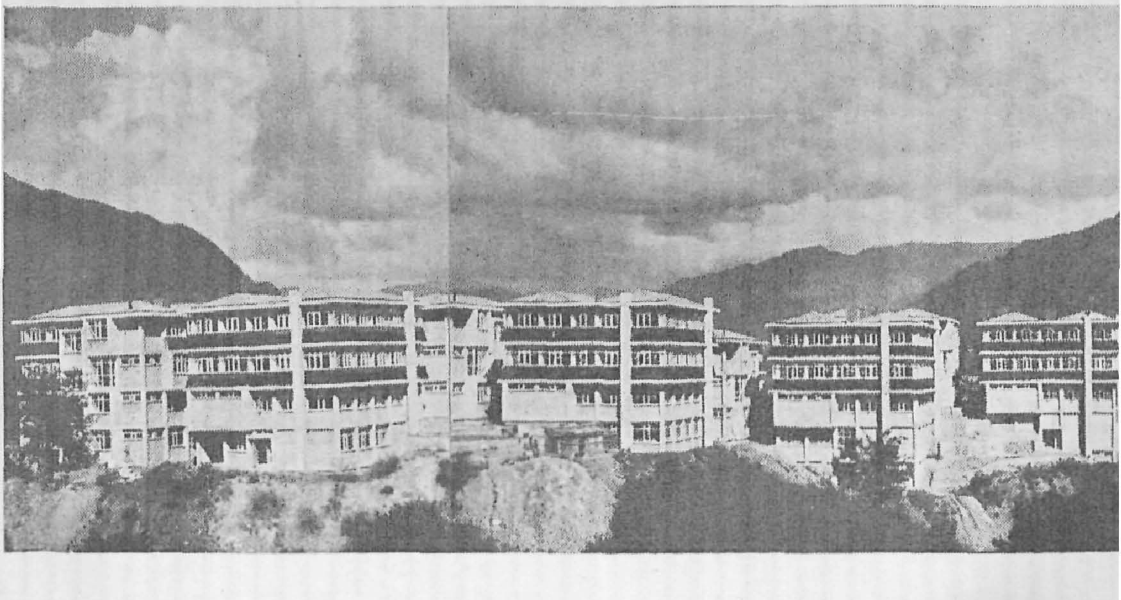


Fig. 47. Himachal Pradesh Krishi Vishwa Vidyalaya, Palampur — new laboratory blocks

Postgraduate degree courses (M. V. Sc.) are offered in the Departments of Animal Physiology, Veterinary Pathology, Veterinary Surgery, Veterinary Gynaecology and Obstetrics, Animal Breeding, Animal Nutrition and Management, Veterinary Parasitology, and Veterinary Bacteriology.

The Faculty has so far produced more than 1 500 graduate B. V. Sc. & A. H., and including the period under Calcutta University more than 80 postgraduate M. V. Sc. and 20 Ph. D. in Veterinary and Animal Science and allied subjects. The intake capacity for the undergraduate programme is about 100 in each academic year and the same for the postgraduate programme is about five in each postgraduate department. A new undergraduate degree programme in Dairy Technology has recently been introduced under this Faculty.

## CHANDRA SHEKHAR AZAD UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, KANPUR (1975)

The Chandra Shekhar Azad University of Agriculture and Technology (established in March 1975) has two campuses—(Kanpur main campus, agriculture) and Mathura (veterinary science). Its jurisdiction covers 21 districts of central and south-west Uttar Pradesh. It offers educational programmes in the faculties of agriculture and veterinary science. The College of Agriculture, Kanpur, is one of the oldest institutions in the country (established in 1906). At present it has 252 faculty members and the number of students on the rolls is about 900. Professor K. N. Kaul is the Vice-Chancellor of this University since March 1975.

The University has inherited most of the infrastructure from the State Government both at Kanpur and Mathura. However, many research farms are yet to be transferred to the University. A comprehensive Master Plan based on long-term research and academic programmes has not yet been prepared.

Integration of teaching, research and extension has yet to be fully achieved. Likewise, programmes of practical training have to be introduced in an integrated manner.

The Veterinary College at Mathura has good reputation and has been one of the leading institutions of higher learning in veterinary education. It offers postgraduate programmes in 13 departments, now proposed to be increased to 16.

The University has taken up the development of a research farm at Dalipnagar near Kanpur, and another at Hazaratganj near

Mathura, both problem areas.

The extension department of the Agricultural College, Kanpur, has been doing good work but on a modest scale due to paucity of funds.

### NARENDRA DEV UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, FAIZABAD, UTTAR PRADESH (1976)

The foundation stone of the Narendra Dev University of Agriculture and Technology was laid at Masodha. Later the site of the University was shifted to Kumarganj on the recommendation of the Committee of scientists constituted by the Government of Uttar Pradesh. The main campus of the University is at Kumarganj. The University has jurisdiction over 15 districts in three Divisions, viz. Faizabad, Varanasi and Gorakhpur, of eastern region of the State. About 1 200 ha of land has been transferred by the State Government to the University at Kumarganj. This land is scattered in about 26 villages.

The State Government transferred five research stations to the University on 1 July 1976.

*Research.* The University has made notable progress in rice research. Paddy Research Station, Masodha, and its affiliated substations have evolved varieties suitable for different agro-climatic conditions of the eastern region.

The University has made a humble beginning in teaching by admitting 24 students in B. Sc. (Agric.) in the first year from October 1978. The classes were started in the Extension Training Centre, Dabhasemar, which was transferred by the State Government to the University. The University has adopted the semester system.

*Vice-Chancellors.* Mr A. D. Pande, the first Vice-Chancellor of this University, took over on 10 October 1975. Under his guidance the guidelines of the Master Plan of the University campus were prepared. The academic plan of the first phase of the University, particularly College of Agriculture, was also completed.

Dr A. S. Yadav, the second Vice-Chancellor, took over on 25 October 1977. The long-pending decision regarding site for the University was cleared and the construction work resumed. The programme of acquisition of 300 ha of good arable land for carrying out experiments under normal soil conditions is in the final stage. Reclamation work has also progressed and about 300 ha of land was brought under cultivation. The research programme of the University was

streamlined. Non-crop research stations were transferred by the State Government and a comprehensive action plan for carrying out work on other crops in these research stations was prepared.

### HIMACHAL PRADESH KRISHI VISHWA VIDYALAYA, PALAMPUR (1978)

Before the establishment of Himachal Pradesh Krishi Vishwa Vidyalaya (HPKVV), the responsibilities of agricultural education, research and extension were carried out by the Agricultural Complex of the Himachal Pradesh University.

The Himachal Pradesh University (HPU), in its Faculty of Agriculture, inherited (*i*) College of Agriculture, Palampur, from Punjab Agricultural University, Ludhiana, in July 1970, and (*ii*) College of Agriculture, Solan, from the State Department of Agriculture, Himalchal Pradesh in July 1971. A forest research division of Himachal Pradesh Forest Department was also transferred to the HPU in 1971. Having been established by the PAU, the College of Agriculture, Palampur, was already operating on the model of an agricultural university, whereas the College of Agriculture, Solan, being affiliated to the Panjab University, Chandigarh, was following the conventional system of education. The HPU therefore inherited two institutions working differently, but both of them soon adopted the common pattern of an agricultural university. The Agricultural Complex enjoyed functional and financial autonomy. The Complex has to its credit the integration of teaching, research and extension, creation of a nucleus of extension education facilities in the State, and strengthening and streamlining of the research stations.

The Himachal Pradesh Krishi Vishwa Vidyalaya, the youngest in the chain of 2 agricultural universities, came into being on 1 November 1978. Dr H. R. Kalia is the Vice-Chancellor of this University.

The State of Himachal Pradesh is mountainous with an area of 56 019 km$^2$. This area, though larger than that of Punjab, Haryana and Kerala, is limited in land resources due to extremely dissected topography and complex nature of geological structures. Operating under such natural constraints, the State could balance its economy by most rational use of its natural endowment by concentrating on agricultural activities in the valley areas, supplemented by animal husbandry base, horticulture and forestry on undulating and steep lands. Besides this, the farm income could be supplemented by taking advantage of the favourable agro-climatic conditions of the State for the

production of certain specialized commodities such as seeds of temperate vegetables, quality mushrooms, medicinal plants, hops, seed potato, ginger and honey. At present the two major campuses of the HPKVV are located in distinct agro-ecological regions: the Solan Campus provides excellent opportunity for research in the area of temperate fruits and forestry, whereas the Palampur Campus provides a scope for development of agriculture and animal husbandry activities suited to valley areas and lower regions of the hills. In addition, the University has 21 research stations—both multipurpose and specialized—scattered all over the State, representing different agro-climatic regions. A research station has been established recently at Lahaul to cater to the need of high-hill agriculture.

*Education.* Two colleges of the University offer instruction leading to Bachelor, Master and Ph.D. degrees in agriculture. Postgraduate programmes in these institutions are limited to 10 disciplines, viz. Agricultural Economics, Agronomy, Genetics and Plant Breeding, Soil Science and Agricultural Chemistry, Animal Husbandry, Horticulture, Plant Pathology and Botany, Entomology and Zoology, Forestry, and Vegetable Crops and Floriculture. To avoid duplication and also keeping in view the agro-ecological conditions of the State, the former five disciplines are located at Palampur and the latter five at Solan. Endeavour is being made to provide specialized knowledge at postgraduate level in different fields of specialization peculiar to hills. This is probably the first university in the country which has instituted a master's degree programme in forestry. The Vishwa Vidyalaya at Palampur offers instruction in science in its College of Basic Science, which awards Pre-University certificates and B. Sc. degrees in medical and non-medical subjects.

The trimester system of education is followed in all the academic programmes of the Vishwa Vidyalaya. Both the colleges of the Vishva Vidyalaya have moderately adequate facilities of hostels. Two separate libraries at each Campus meet the need of books, journals, of students and staff. Two research farms of 1 100 and 1 300 ha provide field facilities for research and instruction at Palampur and Solan respectively.

CHAPTER 31

# PROGRESS OF RESEARCH IN CROP SCIENCES

RESEARCH on the improvement of crods is conducted through the following agencies: (*i*) Central research institutes which are directly administered by the Council; (*ii*) agricultural universities which are autonomous organizations established in different States of the Union; (*iii*) all-India co-ordinated research projects: and (*iv*) *ad-hoc* projects supported from the Agricultural Cess Fund of the Council.

These projects are time-bound and are mostly meant to supplement the all-India co-ordinated research projects primarily on the basic aspects.

In the above-mentioned research set-up, the all-India co-ordinated crop-improvement projects have a pivotal position in making recommendations for the release of new crop varieties as well as in making other recommendations which can be translated into production technology in the farmers' fields. At present there are 23 multi-disciplinary, production-oriented, problem-solving projects in operation at the national level for the improvement of crops. Research on important food, fodder, plantation and commercial crops is under way under these projects. The main objective of the projects is to evolve high-yielding, fertilizer-responsive varieties, with in-built resistance to important pests and diseases and also to work out a package of practices for the economic cultivation of these new varieties. The package of agronomic practices and manurial schedule also goes along with the recommendations for releasing new varieties. Before these recommendations are made, tests are carried out in the farmers' fields with the co-operation of the departments of agriculture.

As a result of above research, a number of high-yielding varieties have been evolved to suit the different conditions in the country. These varieties have made a significant impact on some of the major food crops. For example, in wheat the production in the last decade has risen from almost 12 million tonnes to the projected production of about 30 million tonnes from the 1978 harvest. Similarly, the high-yielding varieties of rice released in the recent years have made tremendous impact on the production of this crop, particularly in the irrigated northern belt of the country where, till recently, rice was not considered an important crop. The success of hybrid cotton, for the first time in the

world, is another major achievement of research in crop improvement. Consequently, the country has become self-sufficient in extra-long-staple varieties of cotton.

Another significant benefit that has accrued from these projects is the increase in the intensity of cropping, consequent upon the introduction of new varieties, making double-cropping and multiple-cropping possible. Mention may also be made of the large-scale adoption of the rice-wheat rotation in areas which were traditionally either wheat areas, e.g. the Punjab State, or rice areas, e.g. West Bengal. Similarly, the jute-rice-wheat and the jute-rice-potato are the rotations which have become popular in the eastern States as a result of the release of early-tuberizing varieties of potato and the introduction of dwarf, fertilizer-responsive varieties of wheat.

To meet the shortage of edible oils in the country, efforts have been made to introduce new crops, e.g. soybean and sunflower, as a source of oil. Sustained research on soybean has already started, making an impact on its production in the *tarai* (submontane) belt of Uttar Pradesh and in some areas of Madhya Pradesh. In the near future this crop is likely to become important as a source of oil and protein. Similarly, sunflower is also showing promise in some parts of the country, particularly in the southern plateau.

As mentioned earlier, the pivotal position in the research effort on crop improvement is occupied by new crop varieties. The objective of this programme was to produce new varieties, combining the useful characters of the *indica* rices with the higher fertilizer response of the *japonica* rices. Hybridization was taken up at the CRRI and the crossed seeds were sent to the various States for selection. There is no doubt that the evolving of improved varieties of rice, the spread of which in the country has been the most important extension activity of the State departments of agriculture, was materially helped by the initiative taken by the Council and the financial assistance rendered by it.

The co-operative *indica-japonica* hybridization programme produced new varieties in some States, but the outstanding example is 'Adt 27', produced in Tamil Nadu. This variety, with its early maturity and non-sensitivity to photoperiod, is capable of producing 4 tonnes/ha of grain with intensive cultivation.

The Council financed a scheme on rice physiology at the Calcutta University for a number of years. The scheme yielded the basic information on the effect of light on the maturation period of rice and on the nutrition of the rice plant. One of the earliest schemes financed by

the ICAR in Tamil Nadu was concerned with investigations on the quality of rice. It was undertaken jointly by the Paddy Specialist, Coimbatore, and the Biochemist of the Indian Institute of Sciences, Bangalore. This scheme produced valuable information on the nutritional quality of rice varieties, the structure of the rice grain, and the changes that take place in the quality of grain during storage, and how it behaves when parboiled, milled and cooked.

Among the schemes financed by the ICAR on the control of diseases, perhaps the most notable example is the work carried out at Coimbatore on breeding varieties resistant to blast.

'Co 25', 'Co 29' and 'Co 30' were the direct outcome of this investigation, and they are being grown widely as blast-resistant varieties. Special investigations were financed by the ICAR for controlling stem-borer in West Bengal and gall-fly in Andhra Pradesh.

For obtaining varieties suitable for growing under unfavourable conditions, such as salt-affected and flooded conditions, special schemes were financed for Orissa, Maharashtra and West Bengal. The salt-resistant variety 'SR 26B', produced in Orissa, is a well-known example.

Among the other schemes financed by the ICAR on this crop, special mention may be made of the project on the botanical survey of rices in the Jeypore tract of Orissa. This survey brought to light valuable material, the study of which, both by the scientists of the CRRI and by some Japanese scientists, has indicated that *Oryza perennis* is the wild progenitor of the present-day cultivated forms. The material is still available at the CRRI for further exploitation.

Though the ICAR did help the rice research in different States, the work at that time was not fully co-ordinated. This inadequate co-ordination has been rectified under the All-India Co-ordinated Rice Improvement Project of the ICAR, now in progress. The recent availability of dwarf varieties, with stiff straw, which can stand intensive fertilization, has completely revolutionized the rice-improvement programme, and the co-ordinated programme has ensured the possibility of improving the yield of rice to two or three times the present level.

A cross, involving 'Taichung Native 1' and 'T 141', did remarkably well and was released by the Central Variety Release Committee in December 1968 under the name 'Jaya'. This variety yields even more than 'IR 8', the so-called 'miracle rice' developed by the International Rice Research Institute. Another variety developed from the same cross ('Taichung Native 1' × 'T 141') and released for general cultivation, along with 'Jaya', is 'Padma'. Its grains are finer than

those of 'Jaya'. It is recommended for growing as a summer crop in parts of Bihar and Orissa. Another merit of 'Padma' is its short duration of 105 days, permitting the farmers to grow it in rotation with

| Variety | Year of release | Area recommended for |
|---|---|---|
| 'IR 8'[1] | 1966 | General cultivation all over India |
| 'Jaya' | 1968 | General cultivation all over India |
| 'Padma' | 1969 | Summer crop in northern Bihar, West Bengal and Orissa |
| 'Jagannath' | 1969 | Lowland, ill-drained soil conditions in eastern India, Orissa, for the *thaladi* crop in Tamil Nadu, Krishna and Godavari deltas in Andhra Pradesh |
| 'Bala' | 1970 | Rainfed, upland areas in eastern U. P., Bihar, West Bengal, Madhya Pradesh, Assam and Orissa |
| 'Cauvery' | 1970 | Rainfed areas of U.P., Bihar and Tamil Nadu |
| 'Kanchi' | 1970 | Multiple-cropped area in Tamil Nadu, U. P., and parts of Gujarat and Madhya Pradesh |
| 'Krishna' | 1970 | Andhra Pradesh, Karnataka, Orissa, Tamil Nadu, the *tarai* area of U. P., part of Gujarat and Madhya Pradesh |
| 'Ratna' | 1970 | Western U. P., Haryana, Punjab, Delhi |
| 'Sabarmati' | 1970 | Western U. P., Delhi and Haryana for the rainy season and north Bihar for the summer crop |
| 'IR 20' | 1970 | Assam, West Bengal, Bihar, eastern U. P., and Orissa for the monsoon crop, and for the *samba* and *thaladi* seasons in the Thanjavur delta in Tamil Nadu |
| 'Vijaya 8' | 1970 | The monsoon crop in eastern U. P., northern Bihar, West Bengal, Assam, parts of Madhya Pradesh and Orissa |
| 'Sona' | 1973 | For general cultivation all over the plains of northern India, except lowland, water-logged areas |
| 'Jayanti' | 1973 | For the monsoon crop in Bihar, West Bengal and Orissa |
| 'Vani' | 1975 | For the monsoon crop in Orissa, parts of Karnataka, U. P., Madhya Pradesh and Rajasthan |
| 'Pusa 2-21' | 1975 | For the monsoon and summer seasons in eastern India (Bihar, West Bengal, Assam, Manipur, Tripura), for the *kuruvai* season in Tamil Nadu |

[1]Evolved at the IRRI, Philippines

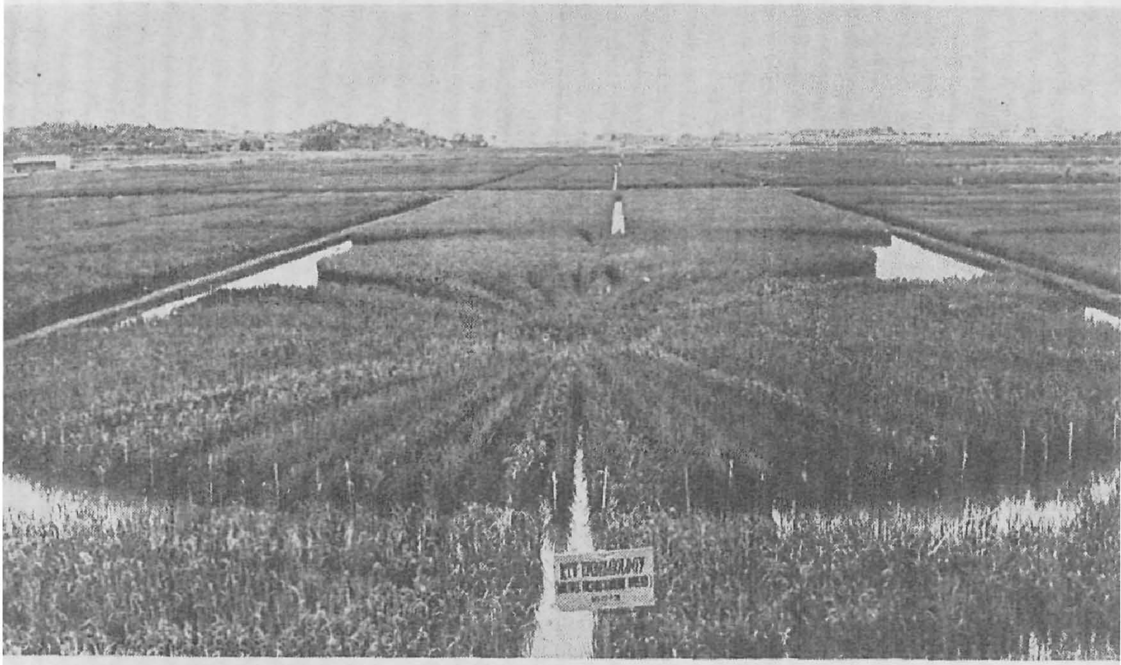
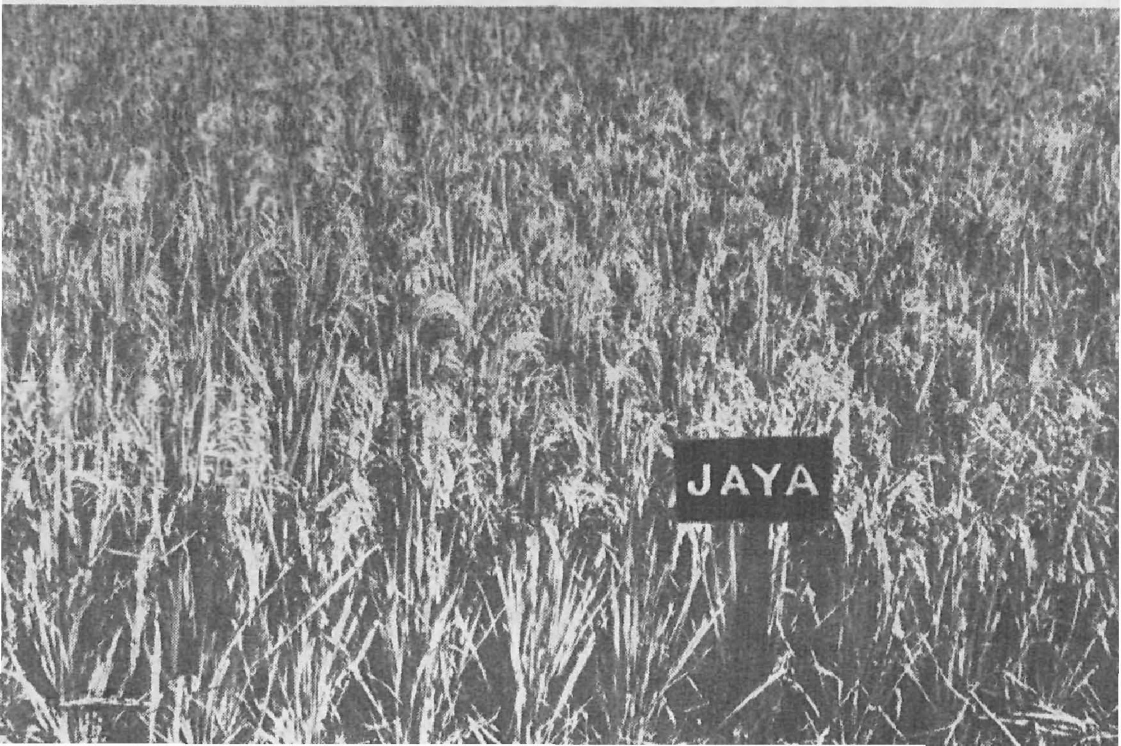


Fig. 48. Circular planting for the screening for rice tungro virus at the AICRIP, Hyderabad

Fig. 49. Rice 'Jaya'



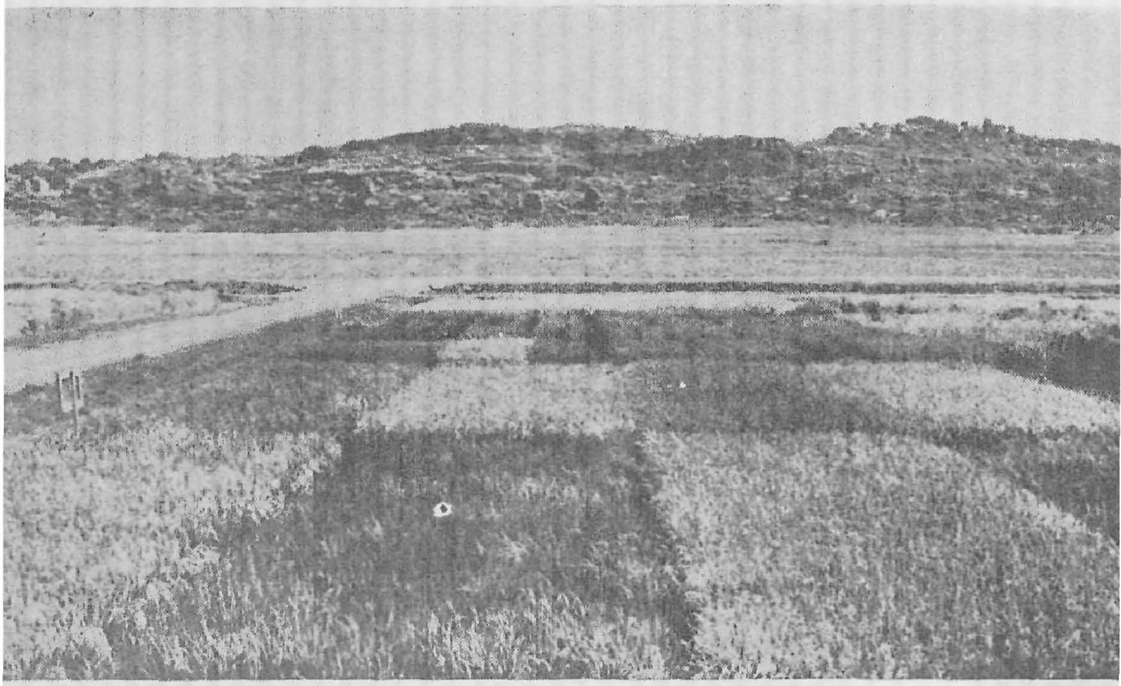
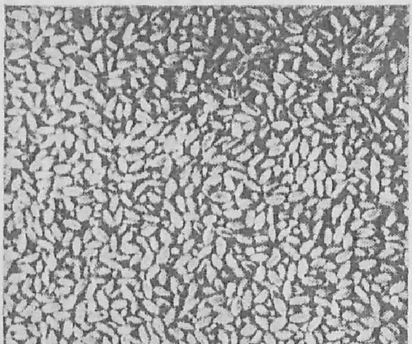


Fig. 50. NPK trials — uniform flowering in phosphate-applied rice fields and delayed maturity in no-phosphate fields, at the AICRIP, Hyderabad

Fig. 51. 'Sonora 64' (*left*) and 'Sharbati Sonora' (right)



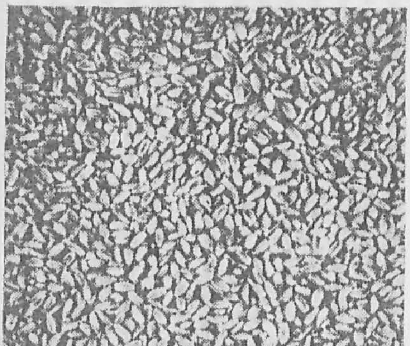


Fig. 52. Wheat 'HD 1982' (Janak) for Bihar and Bengal

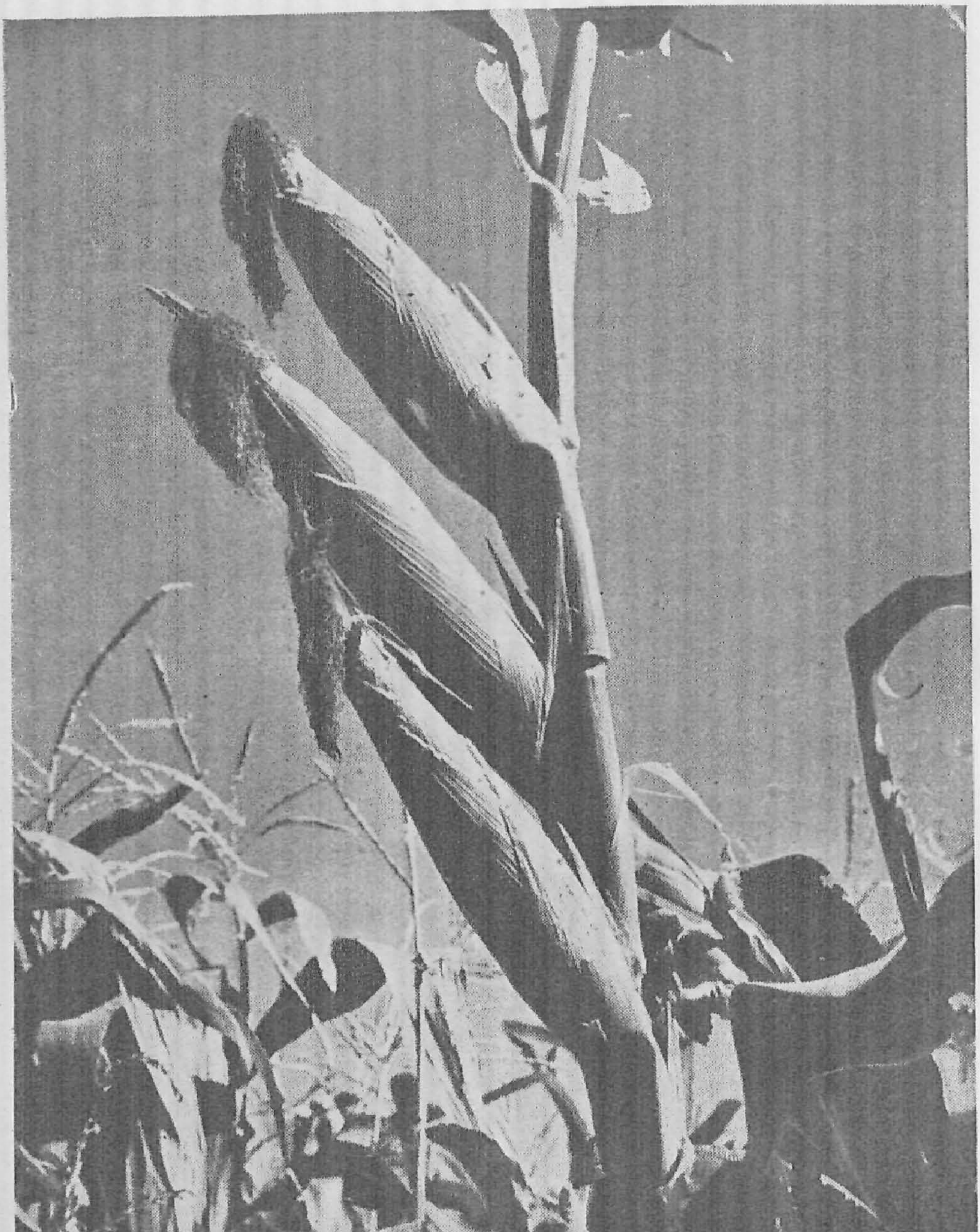


Fig. 53. Maize 'Ganga 5'

potato and jute.

More recently, to meet the requirements of the various regions for varieties adapted to the season (rice being grown up to three seasons in a year in some areas), tolerant to several diseases and pests and possessing better grain quality, a number of new strains have been released under the All-India Co-ordinated Rice-Improvement Project under the names of 'Bala', 'Cauvery', 'Jamuna', 'Kanchi', 'Karuna', 'Krishna', 'Pennai', 'Ratna', 'Sabarmati' and 'Vijaya'. These varieties, listed in the preceding table, have been recommended for specific areas, taking into consideration the desired duration of the crop, the disease problems and the grain quality liked by the farmers.

## WHEAT

During its existence, the ICAR has given great stimulus and support to the improvement of wheat in India. One of the earliest schemes of the Council, soon after it was set up, related to the investigation of the rusts of wheat and barley. Under this scheme, which was drawn up by Professor K. C. Mehta of the Agra College, very important work was done on the identification, life-histories and the incidence of the rusts of cereals in this country. This knowledge ultimately provided the basis for a systematic programme of breeding for disease resistance, which was taken up in 1935 as a co-operative project between the Botany Section of the Imperial (now Indian) Agricultural Research Institute and Professor K. C. Mehta. After the death of Professor Mehta, the plant pathological work also was taken up by the IARI. As a result of collaboration between the wheat breeders and plant pathologists, some outstanding resistant wheat varieties were evolved, the most notable being 'NP 809' which, for the first time in the history of wheat breeding, combined in it a substantial measure of resistance to all the three rusts.

Another very important project financed by the ICAR enabled the setting up of a laboratory at Lyallpur (in the former Punjab Province, now in Pakistan) for determining the milling and bread-making qualities of Indian wheats. This service was of great value to the wheat breeders. But the main contribution of the ICAR was the support it gave to wheat breeding not only at the IARI and its substations, but also to this work in all the major wheat-growing States. This action of the ICAR paved the way for the All-India Co-ordinated Wheat Research Scheme, which is the basis now for conducting an intensive programme of applied research to supply the country with high-yielding

varieties. Provision has also been made for disease-resistance studies as well as for the chemical control of diseases and pests and for the improvement of the nutritive and bread-making qualities of Indian wheats.

The ICAR has also supported basic work in the past on interspecific and intergeneric hybridization of Indian wheats at Pune under the auspices of the Maharashtra Association for the Cultivation of Science.

After the visit of Dr N. E. Borlaug in 1963, seeds of four commercial Mexican semi-dwarf varieties and 613 lines were supplied by the CIMMYT, Mexico. These lines were in various stages of strain development, most of the progenies displaying variation in plant characters. These seeds were made available, in addition to the IARI, New Delhi, to the PAU, Ludhiana, to the Uttar Pradesh Agricultural University, Pantnagar, and to the Central Research Farm of the Uttar Pradesh Department of Agriculture, Kanpur. Some important wheat varieties under cultivation today have originated as selections from this material. Out of 'S 227', 'Kalyan Sona' has been developed through the joint collaboration of the IARI, New Delhi, the Uttar Pradesh Agricultural University, Pantnagar, and the Punjab Agricultural University, Ludhiana. 'Sonalika' was selected out of 'S 308', 'Safed Lerma' from 'S 307', and 'Chhoti Lerma' from 'S 331'. 'Sharbati Sonora' was developed at the IARI, New Delhi, with irradiation, from 'Sonora 64'.

'Kalyan Sona', 'Sonalika', 'Chhoti Lerma' and 'Sharbati Sonora' were released during 1957 and 'Safed Lerma' during 1968. Under high-fertility and irrigated conditions, these varieties give yields which are 2 to 2½ times those of the tall Indian wheat varieties. The cultivation of the two-gene-dwarf wheats has resulted in bumper harvests and has given confidence to the nation to meet its food requirements. More recently, a three-gene-dwarf wheat, 'Hira', has been released for general cultivation. A new *T. durum* variety has also been released for Maharashtra and southern Madhya Pradesh. A zealous research and breeding programme on wheat is in progress, two generations being raised in a year to speed up breeding. Special attention is being given to the problems of disease resistance and grain quality. The varieties released from this project are the following :

| Variety | Year of release | Area recommended for |
|---|---|---|
| 'Kalyan Sona' | 1967 | High-fertility, timely-sown conditions all over India |
| 'Sonalika' | 1967 | High-fertility timely- and late-sown conditions all over India |
| 'Chhoti Lerma', 'Safed Lerma' | 1967 | High-fertility, timely-sown conditions in peninsular India where the races of black and brown rusts develop and a mild short winter prevails |
| 'Narbada 4' | 1971 | Rainfed conditions in Madhya Pradesh and Bundelkhand in Uttar Pradesh |
| 'NI 747-19' | 1965 | Low-fertility, rainfed conditions in Maharashtra |
| 'A 9-13' | 1973 | Low-fertility, rainfed conditions in M. P., in Bundelkhand in U. P., and in Maharashtra |
| 'Meghdoot' | 1973 | Low-fertility, rainfed conditions in M. P. |
| 'Girija' | 1973 | Low-fertility conditions in higher hills in Himachal Pradesh |
| 'NI 5439' | 1973 | Rainfed conditions in Karnataka |
| 'UP 215' | 1973 | Peninsular India |
| 'Malavika' | 1973 | Normal-sown conditions in peninsular India |
| 'MACS 9' | 1973 | Rainfed, low-fertility conditions in peninsular India |
| 'Shera' | 1973 | Late-sown, high-fertility conditions in central India |
| 'Janak' | 1973 | High-fertility, timely-sown conditions in the north-eastern plains zone |
| 'Arjun' | 1974 | High-fertility, timely-sown conditions in north-western plains zone |
| 'Pratap' | 1974 | Low-fertility, timely-sown, rainfed conditions in north-western plains zone |
| 'Raj 911' | 1974 | High-fertility, timely-sown conditions in central zone |
| 'Shailaja' | 1974 | Low-fertility, timely-sown conditions in the lower hills of H. P. |

Some of the wheat varieties released about 12 years ago, such as 'Kalyan Sona', have become susceptible to new races of rust, thereby affecting their productivity. To arrest this trend and to ensure the security of the wheat crop, several steps have been taken, viz. release of new varieties, leading to varietal diversification and the development of multi-lines of 'Kalyan Sona' and 'Sonalika', which will help reduce the build-up of new races. The areas where the rust inoculum gets built up early will also be saturated with resistant varieties.

The last Wheat Workshop identified three multi-line varieties, viz.

'MLKS 11', 'MSML 3' and 'KML 7406', which resemble 'Kalyan Sona' in all morphological and economic characters, but possess a high degree of resistance to rust. In addition, the workshop recommended the high-yielding rust-resistant varieties, 'HW 135' and 'HP 1303', for the north-eastern plains zone, 'HD 2236' and 'Lok 1' for the central zone and 'HW 517' for the peninsular zone.

## MAIZE

*Maize* is grown over 4.6 million ha in India. But until about two decades ago the grain yields were very low. Although the work to improve this crop was started at the IARI as early as 1930, and efforts were also made in some of the States, there was no substantial improvement. The ICAR sanctioned a number of schemes to step up maize production. Thus in 1945 the Council sanctioned a project on maize breeding in the Punjab and a year later another project was started at the IARI. As hybrid vigour in maize is capable of boosting yields substantially, emphasis shifted to this aspect. In 1951 the Council sanctioned a pilot project for the production of 37·5 q of seed of hybrid maize to be operated by the Vivekananda Laboratory at Almora under the direction of Dr Boshi Sen.

In spite of the research achievements, it was felt that something more was needed for a breakthrough in grain production, and the Council invited Dr E. J. Wellhausen and Dr U. J. Grant, well-known maize breeders of the Rockefeller Foundation, who had been working in Mexico, to come to India to study the problems facing the maize breeders of the country, and to evaluate the possibilities of developing hybrid maize suitable for Indian conditions on a commercial scale. These experts submitted their report in March 1955. In pursuance of the suggestions contained in the report, a Subcommittee of the Botany Committee of the Council drew up the first fully co-ordinated crop-breeding project on a regional basis. With some modifications, the All-India Maize-Breeding Project came into operation and was so successful that it served as a model for formulating subsequent projects on other crops.

In the next few years a number of very successful maize hybrids were released, including 'Ganga 1', 'Ganga 101', 'Ranjit' and 'Deccan', whereas a hybrid especially suitable for manufacturing starch was also released. As the next step in the programme, researches were undertaken under the All-India Co-ordinated Project, and as a result six composite varieties, including 'Vijay', 'Jawahar', 'Kisan' and 'Vikram', were

released in 1967 for general cultivation. The development of these composites is a significant advance, as the farmers can produce their own seed and do not have to go back every year to a commercial organization for getting the seeds of the hybrids. The composites have given as high yields as the double-cross hybrids so far released in the country. More recent work on maize has led to the development of hybrids 'Ganga Safed 2', 'Ganga 3', Ganga 5' and 'Him 123'. The high-lysine content associated with the Opaque 2 gene has also been incorporated into the new hybrids. The present varietal position is as follows:

| Variety/ composite | Year of release | Area recommended for |
|---|---|---|
| *Variety* | | |
| 'Ganga 1' | 1961 | Withdrawan from cultivation |
| 'Ganga 101' | 1961 | Withdrawn from cultivation |
| 'Ranjit' | 1961 | Withdrawn from cultivation |
| 'Deccan' | 1961 | Karnataka, Tamil Nadu and Andhra Pradesh |
| 'VL 54' | 1962 | The hilly region of the Himalayas |
| 'Ganga Safed 2' | 1963 | The Punjab, Haryana, Delhi, U. P., Bihar and West Bengal |
| 'Ganga 3' | 1964 | Withdrawn from cultivation |
| *Composite* | | |
| 'Jawahar' | 1967 | The Punjab, parts of Rajasthan, U. P., Delhi and Bihar |
| 'Kisan' | 1967 | The Punjab, Haryana, U. P., Delhi, Bihar and West Bengal |
| 'Vikram' | 1967 | The Punjab, Haryana, Delhi, Bihar and West Bengal, the low-rainfall areas of Rajasthan, Gujarat and the Punjab |
| 'Amber' | 1967 | The Himalayan hills up to 1 700-1 800 m altitude and peninsular India (A. P., Karnataka and Tamil Nadu) |
| 'Sona' | 1967 | The Punjab, Haryana, Delhi, U. P., Bihar and West Bengal |
| 'Vijay' | 1967 | The Punjab, Haryana, Delhi, U. P. and Bihar |
| 'Ganga 5' | 1968 | The Punjab, Haryana, Delhi, U. P., Bihar and West Bengal |
| 'Ganga 4' | 1971 | Madhya Pradesh, Bihar and *tarai* area of Uttar Pradesh |
| 'Ratan' | 1971 | The Punjab and Rajasthan |
| 'Deccan 101' | 1975 | Peninsular India |

## MILLETS

Millets, called the poor man's foodgrains, include grain sorghum

or *jowar*, pearlmillet or *bajra*, fingermillet or *ragi*, and a number of lesser millets. The millets are able to tolerate acidity and are widely grown in areas of low and uncertain rainfall. Though the Council sanctioned about 30 schemes for research on millets from time to time, the programme got a real impetus only in 1961, when it sanctioned the Accelerated Sorghum-Improvement Project for evolving high-yielding grain sorghums. Two high-yielding sorghum hybrids, viz. 'CSH 1' and 'CSH 2', were released in 1964 and 1965, respectively, after extensive field-testing for commercial cultivation in the country. The hybrids have given grain yields of 4 000 to 6 000 kg/ha, representing an increase of 60 to 80% over the local varieties of *jowar*. In 1968, a *jowar* variety, 'Swarna', was developed and released. It yields almost as high as 'CSH 1' and has the advantage that the farmer can easily keep his own seed for growing successive crops. The sorghum programme has yielded the following hybrids and varieties suitable both for *kharif* and *rabi* seasons.

| Variety | Year of release | Area recommended for |
|---|---|---|
| 'CSH 1' | 1964 | In all sorghum-growing States in India |
| 'CSH 2' | 1965 | Karnataka |
| 'CSV 1' ('Swarna') | 1968 | Maharashtra, A. P. and Karnataka |
| 'CSH 3' | 1970 | Karnataka, A. P., M. P., Rajasthan and Maharashtra |
| 'CSH 4' | 1970 | Maharashtra and for the *rabi* crop in A.P., Karnataka and Tamil Nadu |
| 'CSH 5' | 1974 | The monsoon and the *rabi* crop in Gujarat, Maharashtra, A. P. and Karnataka |
| 'CSV 2' | 1974 | The monsoon season in Maharashtra, A. P., U. P., M. P. and Rajasthan |
| 'CSV 3' | 1974 | Maharashtra, A. P., Karnataka, M. P. and Rajasthan |
| 'CSV 4' | 1974 | Maharashtra and Karnataka, A. P. and Tamil Nadu |
| 'CSV 5' | 1974 | The *kharif* season in Maharashtra and Karnataka; the *rabi* season in A. P. and Tamil Nadu |
| 'CSV 6' | 1974 | Maharashtra, A. P., Karnataka, M. P. and Tamil Nadu |
| 'CSV 7' | 1974 | The *rabi* season in Tamil Nadu, Maharashtra, Karnataka and Andhra Pradesh |

In *bajra* the first hybrid, 'HB 1', was developed by the PAU, Ludhiana, and was released in 1965. It proved very popular with the farmers. Later three more hybrids were developed and released under the co-operative research programme sponsored by the Council. Re-

search on *bajra* and also on the lesser millets has now been intensified under the All-India Co-ordinated Millets-Improvement Project.

The initial hybrids of *bajra*, such as 'HB 1', 'HB 3' and 'HB 5', succumbed to downy mildew and ergot. Newer hybrids with in-built resistance have been recently developed. The newer hybrids and their area of adoption are given below:

| Variety | Year of release | Area recommended for |
|---|---|---|
| 'PHB 10' | 1974 | Resistant to downy mildew |
| 'PHB 14' | 1974 | Recommended for general cultivation all over the *bajra*-growing States in India |
| 'BJ 104' | 1975 | Resistant to downy mildew; recommended for all States |
| 'BK 560' | 1975 | Resistant to downy mildew; recommended for all States |

PULSES

India grows a variety of grain legumes, called pulses. They constitute an important article in the Indian diet. Gram or chickpea (*Cicer arietinum*) is the most important pulse crop of India in terms of area and production. The next in importance is *arhar*, also known as *tur*, redgram or pigeonpea (*Cajanus cajan*). The others are *moong* (*Vigna radiata*, syn. *Phaseolus aureus*), *urd* (*Vigna mungo*; syn. *Phaseolus mungo*), lentil or *masoor* (*Lens culinaris*), *moth* (*Phaseolus aconitifolius*), field-pea (*Pisum sativum* var. *arvense*), grain cowpea (*Vigna unguiculata* subsp. *cylindrica*) and many others. Since its inception, the Council has sanctioned research schemes on pulses, a majority being those devoted to the evolvement of better varieties through selection from local populations or through varietal hybridization. A number of improved varieties of pulses have been evolved under these schemes.

For giving fillip to the overall improvement of this important protein-giving group of crops, the Council is currently operating an All-India Co-ordinated Pulses-Improvement Project. Large collections of germplasm have been built up for this research programme, which aims at developing high-yielding, short-duration varieties of pulses for unirrigated conditions, or varieties which would fit in with profitable crop rotations, especially under irrigated farming. The work done so far has resulted in a number of very early-maturing types of *arhar*, some promising types of gram and disease-resistant lines of *moong* and

*urd.* As more work needs to be done, research on pulses is being stepped up.

A National Directorate of Pulses Research was established at the Regional Research Station, Kanpur, in addition to the strengthening of new centres of research under the All-India Co-ordinated Project during the Fifth Plan. The new varieties under different pulses evolved under this project are given below.

| Variety | Year of release | Area recommended for |
|---|---|---|
| *Pigeonpea* | | |
| 'Ageti' | 1971 | For the *arhar*-wheat rotation in Haryana, the Punjab, U. P. and M. P. |
| 'Sharda' | 1971 | For the *arhar*-wheat rotation in Haryana, the Punjab, U. P., Bihar and M. P. |
| 'Mukta' | 1971 | Eastern U. P., Bihar, M. P. and Maharashtra |
| 'Type 21' | 1961 | U. P., Haryana, Punjab, M. P. and Bihar |
| *Gram* | | |
| 'G 24' | 1972 | The Punjab and Haryana |
| 'G 236' | 1960 | The Punjab, Haryana, U. P. and M. P. |
| 'T 3' | 1959 | U. P., M. P., Bihar, Haryana and the Punjab |
| *Greengram* | | |
| 'Pusa Baisakhi' | 1971 | For the summer crop on the wheat fallows in U. P., Bihar and the monsoon crop in western India |
| 'Jawahar' | 1973 | For the monsoon crop in M. P., U. P. and Haryana |
| 'T 44' | 1960 | For the monsoon and summer crops in U. P. and Haryana |
| *Blackgram* | | |
| 'T 9' | | U. P., Bihar, Haryana, the Punjab, Rajasthan, M. P. and Maharashtra |
| 'Mash 2' | 1972 | Haryana and the Punjab |
| *Lentil* | | |
| 'L 9-12' | 1972 | Haryana, the Punjab, U. P. and M. P. |
| 'Pea 163' | 1972 | U. P., Bihar, M. P., Haryana and the Punjab |

## OILSEEDS

India grows a wide range of oilseed crops, the principal among them being groundnut, rapeseed and mustard, linseed, sesame, castor and safflower. Although about 10% of the cultivated area is devoted to oilseed crops, the present production of 9.8 million tonnes is far

Fig. 54. 'CSH 1', the first sorghum hybrid

Fig. 55. Sorghum 'CSH 5'

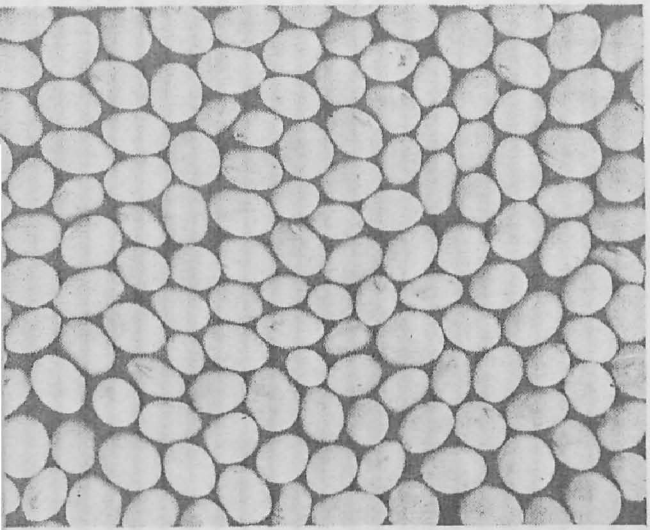
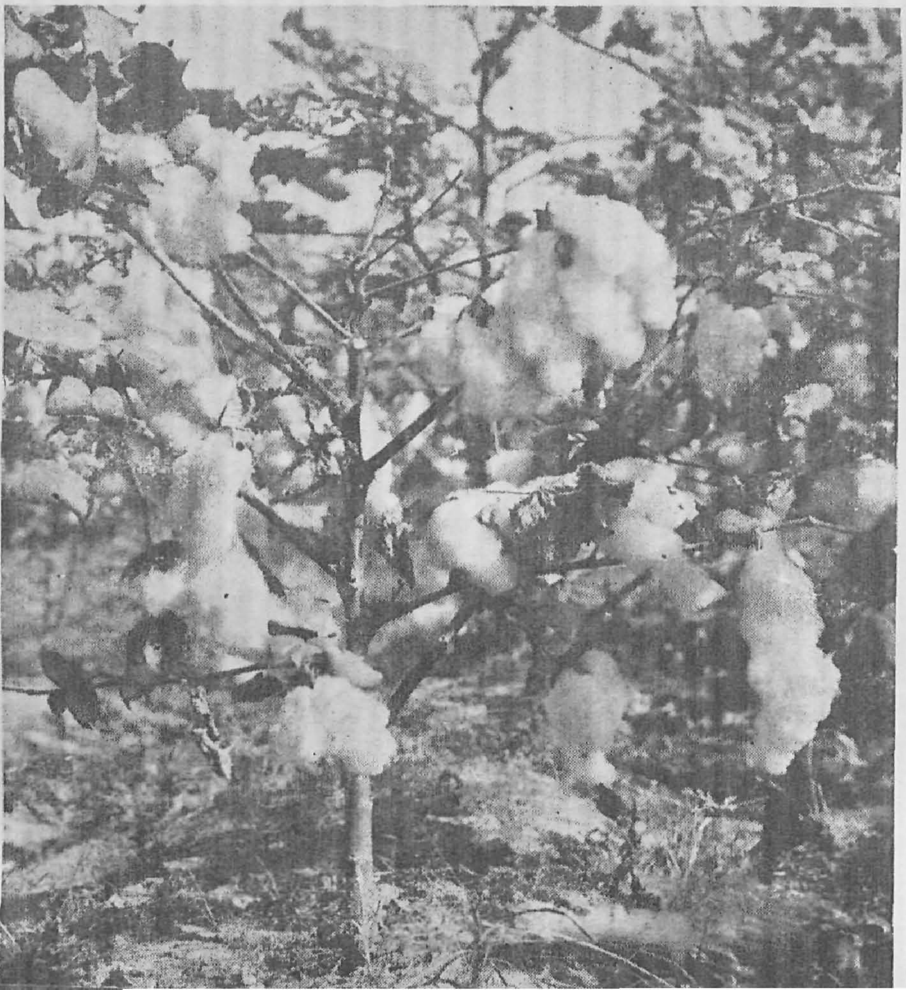


Fig. 56. Soybean 'UPSM 534'

Fig. 57. Cotton variety '29141' at the IARI, New Delhi



short of the country's requirements.

Before the transfer of its research function to the ICAR in 1966, the Indian Central Oilseeds Committee supported a number of research schemes for the improvement of a number of locally adapted improved types of Indian mustard (*rai*), Indian rape (*toria*), yellow sarson (*sarson*) and groundnut. Some useful research on the development of varieties of linseed resistant to rust and wilt was also carried out at the IARI. However, keeping in view the need for a breakthrough in the production of various types of oilseeds required for human consumption and for the paint and varnish industry, etc., the Council drew a comprehensive all-India research project, under which attention was given to all the major oilseeds produced in the country. Special attention was also given to the possibility of using sunflower as a source of oil on a big scale in suitable areas. Two of the varieties imported from Russia, viz. 'Armaviskij' and 'Armavarts', appear to be promising because of their very satisfactory yield, short duration and ability to stand a fair degree of drought.

Whereas the productivity of oilseeds has declined in the past few decades, it is not adequately recognized that the decline perhaps would have been sharper but for research and developmental efforts. The past few years, particularly the seventies, have really shown how research and development have increased productivity and production of oilseeds.

The most impressive example to illustrate this point is that of castor. Over the past 20 years castor productivity was stable at a very low level of about 200 kg/ha. This was the period when long-duration traditional varieties had been grown. From 1966-67, owing to research efforts of the breeders in the All-India Co-ordinated Research Project on Oilseeds, a series of high-yielding early-maturing varieties and hybrids were released in quick succession. They made an immediate impact on production. The national productivity of castor has shown a steep ascent. In 1973-74 it stood at 419 kg/ha—giving almost a 100% increase. But in the States, such as Gujarat, the increase was spectacular. For the first time in 1974, the State productivity of castor crossed the 1-tonne barrier. This was mainly due to the large-scale cultivation of hybrid castors, e.g. 'GCH 3'. New hybrids, better than 'GCH 38', have now been evolved and are spreading fast. The variety 'Aruna' of castor has covered the castor belt of Andhra Pradesh and is primarily responsible for trebling castor production in that State in recent years. Today the country is not only self-sufficient in

## MUSTARD

The variety 'Prakash' of mustard (*Brassica juncea*) has given 20% higher yield than 'RL 18'. The new variety has a yield potential of 32 q/ha, with an oil content of 39%. It has also been found to be resistant to drought as well as to frost.

'Varuna', which gave higher yield than the locals, was released for cultivation in Gujarat, West Bengal and Uttar Pradesh. In 1976 'T 4' was found resistant to white rust and hence was recommended in the areas where white rust is prevalent.

'T 27' has given 30% higher yield than 'ITSA' at Hissar under a spacing of 15 cm × 15 cm, giving an average seed yield of 2 083 kg/ha for 3 seasons successively.

## SAFFLOWER

Three varieties of safflower, viz. 'Manjira', 'Tara' and 'T 65', were released in Andhra Pradesh, Maharashtra and Uttar Pradesh respectively. Very high oil-yielding (up to 50%) types, viz. 'JI 1', 'JI 2' and 'JI 3', have been isolated at Jalgaon. Intensive efforts are being made to develop varieties to suit irrigated, saline and alkaline conditions and those resistant to rust.

## LINSEED

The linseed variety 'Jawahar' released by the JNKVV, Jabalpur, has been recommended for large-scale demonstration trials under *utera* type of cultivation. A bold-seeded variety 'Ut 1' has been released in Rajasthan. It matures in 120 days, and is also moderately resistant to rust and wilt.

## SUNFLOWER

In addition to the four Russian introductions, the early-maturing (75-80 days) 'Mordon' has been identified. Selection 'AS 37' ha sbeen released for cultivation in the Vidarbha region of Maharashtra.

## SUGARCANE

Sugarcane research in India has been carried on at the Sugarcane Breeding Institute, Coimbatore, and at the Indian Institute of Sugarcane Research, Lucknow, and also under the aegis of the departments of agriculture in different States. The National Sugar Institute at Kanpur is devoted to technological research on sugar and other allied products. The Sugarcane-Breeding Institute was started in 1912 as the Sugarcane-Breeding Substation of the Imperial (now Indian) Agri-

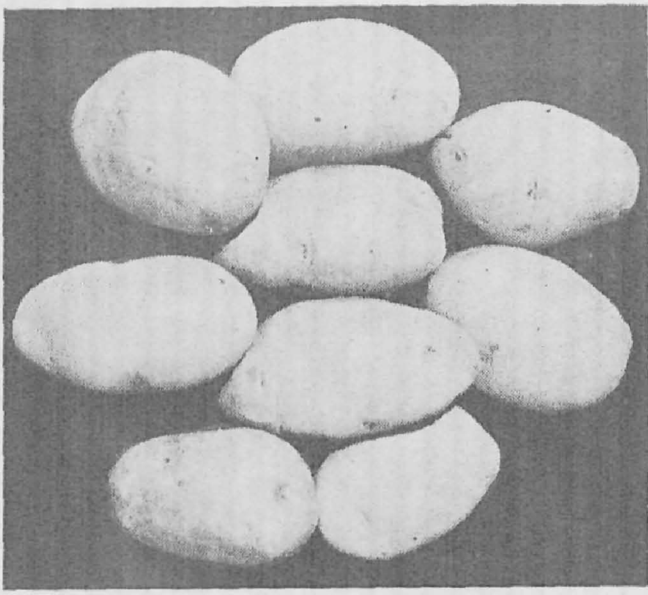


Fig. 58. Potato 'Kufri Chandramukhi'

Fig. 59. A healthy seed crop of potato raised through seed-plot technique

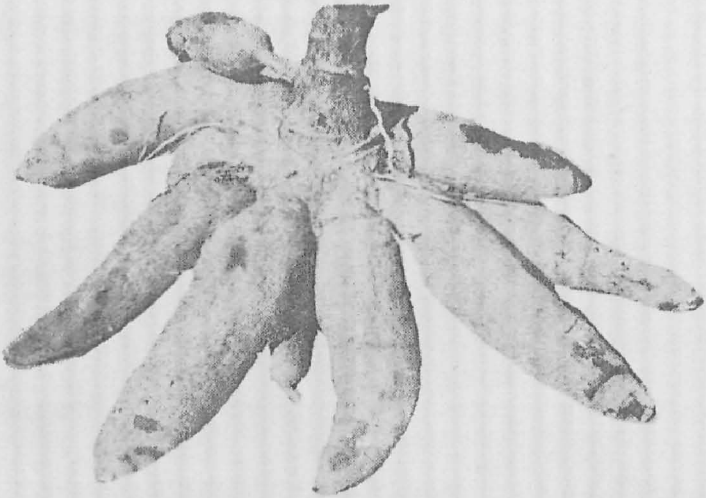


Fig. 60. Cassava hybrid 'Sree Visakham' ('H 1687')

Fig. 61. Plant introduction—clusterbean

cultural Research Institute. In 1924 it became a full-fledged institute. The institute at Lucknow was set up in 1952. In 1969 the new institutes were transferred to the ICAR. The Indian Central Sugarcane Committee set up by the Government of India in 1944 sponsored, till its abolition in 1966, a number of sugarcane research projects at the Central institutes and in the States, primarily in sugarcane agronomy and on the pests and diseases of the crop. In keeping with its policy, the Council has taken steps to draw up a co-ordinated scheme, so that sugarcane research, which was largely concentrated at the two Central institutes, will now be undertaken on a national basis.

A number of cane varieties, which were evolved at the SBI, have been tested in different States and have been released for cultivation. The names of the varieties and the percentages of area covered by them are given in the table.

| State | Variety | Area (%) covered to the total area reported |
|---|---|---|
| Uttar Pradesh | 'Co 1148' | 33.66 |
| | 'Co 1158', | 13.54 |
| | 'Co S510', | 5.54 |
| | 'Co 975' | 2.29 |
| | Others : 'Co S109' | |
| | 'Co S 541', 'Co 650', | |
| | 'Co 1007', 'Co 650', | |
| | 'Co 846', 'Co S 443', | |
| | 'Co S 416' | |
| Maharashtra | 'Co 740' | 54.90 |
| | 'Co 775' | 0.20 |
| Bihar | 'Co 658' | 1.52 |
| | 'Co 1158' | 0.18 |
| Haryana | 'Co 975' | 47.20 |
| | 'Co 1148' | 14.36 |
| | 'Co L 9' | 3.75 |
| | 'Co S 29' | 3.17 |
| | 'Co J 46' | 2.00 |
| | Others : 'Co J 30', | |
| | 'Co 1158' | |
| Tamil Nadu | 'Co 658' | 10.97 |
| | 'Co 740' | 2.40 |
| | 'Co 858' | 0.71 |
| | 'Co 6304' | |
| Punjab | 'Co J 46' | 31.79 |
| | 'Co 1148' | 10.24 |
| | 'Co L 29' | 2.50 |

| State | Variety | Area (%) covered to the total area reported |
|---|---|---|
| | Others: 'Co 1158', 'Co 975', 'CoL 9' 'Co J 39', 'Co J 58' | |
| Andhra Pradesh | 'Co 997', | 24.83 |
| | 'Co 975' | 1.16 |
| Karnataka | 'Co 740' | 8.34 |

To meet the requirements of the different States for genetic material of high-yielding varieties with higher sugar content, a National Hybridization Garden has been established at the Sugarcane-Breeding Institute, Coimbatore. This Institute, after ascertaining the requirements of the different States, plants the parent material under the National Hybridization Garden. During the flowering season (October to December), the States indenting genetic material send their own representatives to make the crosses and collect the seed material for taking back the new crosses for location testing in their States.

The evolvement of a number of genotypes for their suitability as short-duration varieties has of late indicated a great scope for harvesting the cane crop at 240 days. This duration also indicated the potential for raising three short-duration crops of sugarcane in two years, against only two crops of mid-late varieties. These short-duration varieties ('Co A 7601', 'Co 7201, 'Co 7204') had more than 18% sucrose at 240 days compared with 12% of the mid-late varieties. Mill tests, with chemical ripeners, in sugarcane have also pointed to the prospect of utilizing *polaris* on a large scale under difficult-to-ripen conditions (the southern coastal area of Tamil Nadu and Andhra Pradesh, where climatic conditions are not ideal for early ripening). This process can enhance the content of sucrose by 6 to 19%.

## COTTON

Work done under the cotton-breeding projects sponsored by the Indian Central Cotton Committee, established in 1921, led to the development of a large number of improved varieties of local (*desi*), American upland and Cambodian cottons. The Committee set up and maintained a Cotton Technological Research Laboratory at Matunga, Bombay, to promote research on cotton and step up its development. Since the transfer of research on cotton to the ICAR in 1966, consequent upon the abolition of the Indian Central Cotton Committee, work on the improvement of this crop has been geared to the national requirements under the All-India Co-ordinated Cotton-Improvement Project. One

of the most significant results in cotton production has been the use of 'Hybrid 4' cotton, which has given a phenomenal yield up to and even above 50 q/ha. Our cotton requirements are going up, and projections show that by 1984 we may need 9.5 million bales of raw cotton.

The break-up of cotton requirement, according to staple length, is given in the next table (on page 298).

Currently, our cotton-mills use 6.4 million bales annually. One-eighth of it, mostly of superfine quality, is imported for blending it with polyester to combine the comfort of cotton with the easy-care properties of artificial fibres.

*Production research.* The main objectives of the cotton-improvement programme in the country is to evolve better-yielding varieties of cotton in the various quality groups suitable for different agro-climatic conditions, based on an assessment of the quantitative and qualitative requirements of cotton by the Indian textile industry. The development of improved agronomic practices and crop-protection schedules for realizing high yields from newly released varieties also forms an essential part of the cotton-development programme.

To intensify research on cotton, the ICAR sponsored the All-India Co-ordinated Cotton-Improvement Project in April 1967. The work under this project is carried on at about 30 research centres, representing the different agro-climatic regions in the country and involves inter-institutional co-operation and multi-disciplinary approach.

As a result of the significant work carried out under this project in close collaboration with the Cotton Technological Research Laboratory, Bombay, new varieties of cotton, with better yield and quality, were identified for releasing during 1968-74. The release of hybrid cottons 'Hybrid 4' and 'Varalaxmi', and superior long-staple and extra-long-staple varieties, 'MCU 5', 'Sujata' and 'Suvin', constitutes a significant event in cotton production.

In 1971 the world's first commercial cotton hybrid, 'Hybrid 4', was released, followed by 'Varalaxmi' in the following year. The hybrids are extremely popular on account of their very high yield potential. To cut down the cost of producing hybrid seed, male-sterile lines, e.g. 'Gregg', are being used in hybridization.

The hybrids and the new better-yielding varieties have made a significant contribution to the quantitative improvement and qualitative change in the Indian cotton crop.

A number of varieties were on the breeders' assembly line by the end of the Fourth Plan.

Cotton requirement according to staple length

| Count group of yarn | Staple-length category | Demand (million bales) |
|---|---|---|
| Superfine (48s and above) | Extra-long-staple (1-3/16" and above; 30.16 mm and above) Long staple (31/32" to 37/32"; 24.61 mm to 29.37 mm) | 1.1 |
| Fine (37s to 48s) | Long staple (31/32" to 37/32"; 24.61 mm to 29.37 mm) | 1.3 |
| Superior medium (26s to 36s) | Superior medium (28/32" to 30/32"; 22.23 mm to 23.81 mm) | 4.0 |
| Lower medium (17s to 26s) | Medium staple (25/32" to 27/32"; 19.84 mm to 21.43 mm) | 1.6 |
| Coarse (up to 17s) | *Short staple* (24/32" and below; 19.05 mm and below) | 0.5 |
| | Total | 8.5 |

The varieties recommended for release in the country, and varieties likely to be available for development in the near future are given in the next table.

New promising cotton varieties

| | |
|---|---|
| *Extra-long-staple varieties* | |
| Staple length 1-3/32" and above (30.16 mm and above) | |
| Released varieties in commercial cultivation | 'Gujarat 67', 'Sea Island', 'Andrews', 'MCU 5', 'MCU 4' |
| New varieties under initial spread | 'MCU 8' (top grade), 'Suvin', 'CBS 156', 'IAN 579/188' |
| Varieties under trial | 'Hybrid 5', 'Nandyal Hybrid', ('Gujarat 67' × 'Suvin') |
| *Long-staple varieties* | |
| Staple-length classification | |
| Superior Long (34 to 37") | Long (31 to 33") |
| 32 | 32 |

| | | |
|---|---|---|
| (26.99 mm to 29.37 mm) | | (34.61 mm to 36.19 mm) |
| Released varieties | | |
| New World species<br>'Deviraj', 'Hybrid 4'<br>Lower grades of<br>'MCU 5', 'MCU 4',<br>'MCU 8' and 'Varalaxmi' | | 'J 34', 'J 205', 'RS 80',<br>'B 147', 'B 1007', 'Badnawar 1',<br>'Mysore 141', 'MCU 1', 'MCU 2',<br>'PRS 72', 'Krishna' |
| Asiatic species | | 'Karunganni 7', 'Karunganni 8' |
| Promising varieties under trial | | |
| New World species | 'CP 1998-F',<br>'CP 15/2',<br>'PS 16' | 'H 297', 'PS 10', 'SS 167',<br>'Reba B 50', 'CP 23/8', 'CPH 1',<br>'IC 1824', 'D 13', 'D 40' |

*Medium-staple varieties*

Staple-length classification

| | | |
|---|---|---|
| Superior<br>Medium (28 to 30″)<br>32 | | Medium<br>(25 to 27″)<br>32 |
| (22.23 mm to 23.81 mm) | | (19.84 to 21.93 mm) |
| Released varieties | | |
| New World species | '320', 'H 14', 'J 34', 'LSS',<br>'J 200', 'Pramukh',<br>'Narbab', 'Khandwa',<br>'Laxmi P',<br>'216 F', 'CS 23',<br>'SRT 1' | 'Hamp.', 'C Indore 1', |
| Asiatic species | 'V 757', 'Digivjay',<br>'Sanjay', '2943', 'Y 1',<br>'Gaurani 46', 'AK 236',<br>'AK 277', 'Jayadhar',<br>'Suyodhar', 'Nandicum',<br>'Adonicum' | 'Miljari', 'Westerna',<br>'Coconadas White', '741'<br>'Coconadas 2', 'Jyoti' |
| Promising varieties under trial | | |
| New World species | 'J 207', 'SS 25', 'RS 545',<br>'RS 263', 'BH 30/9',<br>'AC 719', 'AC 738, 'AC<br>717', 'IJK 97', 'JK 79',<br>'CPD 8-1', 'JK 125-2',<br>'CP 5/2', 'IC 187', 'IC<br>2028', 'IC 473', '1412',<br>'PRH 026', 'CPH 2',<br>'CPH 4' | 'Bikanari Narma'<br>(under natural spread),<br>'LH 38', 'SH 131',<br>'RS 437', 'B 72 2889',<br>'B 5501', '71/1', 'IAN<br>5131' |
| Asiatic species | 'AKH 4', 'JD 415',<br>'355 K 6' | 'JD 414' |
| | Short-staple cotton varieties, 24/28″ and below (19.05 mm and below) | |
| Released varieties | | |
| *Gossypium arboreum* | '231-R', 'G 27', 'RG 1', 'Shyamali', 'Lohia' | |

The pay-off under the All-India Co-ordinated Cotton-Improvement Project might be said to have been achieved from the 1971-72 season, with the launching of the Intensive Cotton District Programme by the Government of India, based on the results of research from the Project.

Some stability in cotton production has been imparted from this season (1973-74) onwards in spite of the seasonal hazards, as evidenced from the estimates of cotton production (especially trade figures) and actual consumption of Indian cotton by the industry from 1971-72 to 1973-74.

Since the projected requirement is about 5.5 million bales (out of the total 9 million bales) of medium-staple cotton, further research and development strategy for increasing cotton production in the country has laid emphasis on medium-staple cotton for meeting the requirements.

Further, to achieve stability in the production of rainfed cotton, which constitutes 75% of the area under the crop, the development of varieties with high ginning outturn, thereby securing increased yield of lint per unit area, has been given a high priority in the breeding of medium-staple cotton.

About 30 varieties were developed under the All-India Co-ordinated Cotton-Improvement Project and were on the breeder's assembly line during 1974. They include new hybrids ('CPH 2' and 'CPH 4', evolved from the male-sterile 'Gregg' line).

*Protection against diseases and pests. Verticillium* wilt is serious in the south, particularly on *G. hirsutum* varieties. Resistant elite varieties, 'Sujata' and 'Suvin', partly solved the problem. A tolerant selection of 'MCU 5' is under trial on the farmers' fields. Besides soil fumigation, rotation with rice has been found to reduce the incidence of wilt. Biological control of this wilt is also possible through *Trichoderma viridis*.

Varieties resistant to both jassids and bacterial blight have been developed. The sex-attractant Gossyplure was successful in luring pink bollwormt away from fields.

Growth-promoters, when used in the right dose and at the right stage, like napthalene acetic acid, increase boll retention. This practice is coming into general use. In the northern zone, Cycocel application checked unnecessary vegetative growth and increased fruiting and yield, but results from other areas are inconclusive.

*Cotton and man-made fibre.* In many parts of the world cotton is facing serious competition from man-made fibres, which possess easy-care properties. The technological challenge from man-made fibres is

being met in the Indian cotton-improvement programme through two approaches : (*i*) identifying cotton varieties suitable for blending with man-made fibres and, (*ii*) developing cotton varieties suitable for chemical finishing treatment used to impart easy-care properties to cotton garments.

'Hybrid 4', 'Varalaxmi', 'MCU 5', 'Sujata' and 'Suvin' have all been eminently suitable for blending with man-made fibres, thus offering great scope to the Indian textile industry for making use of these cottons for producing blended fabrics. Studies at the Cotton Technological Research Laboratory, Bombay, have shown that the extra-long-staple varieties 'Sujata' and 'Suvin' possess the fibre strength and other mechanical properties suitable for chemical finishing treatments to impart easy-care properties.

The new hybrids and varieties of cotton and the new technology made available by the All-India Co-ordinated Cotton-Improvement Project have made significant contribution to quantitative improvement and qualitative change in the Indian cotton crop and have taken the country towards the goal of self-reliance in this important commercial crop.

During the Fifth Plan, the Central Institute for Cotton Research was established at Nagpur. It takes up basic research relating to increasing the yield potential of rainfed cotton in the country, with a regional centre at Coimbatore to cater for the needs of the irrigated cotton in the southern region.

## JUTE

Considerable research has been carried out under schemes sponsored by the Indian Central Jute Committee (established in 1936) on the improvement of jute, both white jute (*Corchorus capsularis*) and tossa jute (*C. olitorius*), and mesta, both *kenaf* (*Hibiscus cannabinus*) and roselle (*H. sabdariffa*), and also other fibre crops, such as sunnhemp (*Crotalaria juncea*), ramie (*Boehmeria nivea*) and *sisal* (*Agave sisalana*). To promote research and development in jute and other fibre crops, the Committee set up the Jute Agricultural Research Institute at Dacca in 1937. It was re-established near Barrackpore (West Bengal) after the country's partition. The technological aspects of jute research are looked after by the Jute Technological Research Laboratories located at Calcutta. Both the institutes are now with the Council, which has introduced a co-ordinated research scheme operating in several jute-growing States.

The production of raw jute in India was 1.6 million bales in 1948, which reached the mark of 6.3 million bales by 1967. Thereafter the area under the production of jute could not be stabilized owing to fluctuations in the rainfall pattern and in the prices of raw jute. New areas with irrigation were switched over to food crops in preference to jute and hence researches were intensified at the JARI, Barrackpore, to achieve higher yields. Varieties suitable for multiple-cropping or to a particular agro-climatic zone were evolved and released, both for irrigated and unirrigated regions. Technological researches were taken up at the JTRL, Calcutta, to upgrade fibre quality and to find diversified uses of fibres, agricultural by-products and industrial wastes.

New improved varieties, viz. 'JRO 878', 'JRO 7835' and 'JRO 4774' of jute, and 'HS 4288', 'AMV 1' and 'HC 585' of mesta, having an average fibre yield exceeding 26 q/ha, have been released and the supply of nucleus seed has been assured with the establishment of the Central Nucleus Jute Seed-Multiplication Farm at Budbud, Burdwan.

Simultaneously, researches on soils and nutrient uptake helped formulate acceptable recommendations. The jute-producing area has been broadly classified into nine zones, and the fertilizer or manurial requirements for each zone have been enunciated in detail. In general, it has been found most economical to use fertilizers.

It was found that the magnesium requirement of jute was high and that boron played a crucial role in its development. The application of magnesium and boron in deficient tracts contributed to high yield. The placement of phosphatic fertilizer 10 cm below the jute seed gave optimum results, but most of the Gangetic alluvium needed no phosphate application. In acidic soils in high-rainfall areas in the sub-Himalayan jute belt, the requirement of phosphorus and its appropriate source have been worked out.

The ratios of $K_2O : CO_2$ in the soil and plant were found to be indicators of susceptibility to stem-rot and root-rot of jute. This finding provided clues for the control of diseases largely through cultural practices. Consequently, epidemics of stem-rot and root-rot of jute have become rare. Leaf-mosaic in jute has been found to be transmitted through pollen and seed, and thus was effectively reduced by roguing at the seed-multiplication centres. A vector has recently been found active in Assam. The Hooghly wilt continues to be a menace, but the causal organisms *Fusarium solani*, *Pseudomonas solanacearum* and *Macrophomina phaseloi* have been identified and their *modus operandi* has been understood to work out a suitable control technique.

Fig. 62. Napier grass

Fig. 63. Tomato, 'Pusa Ruby'

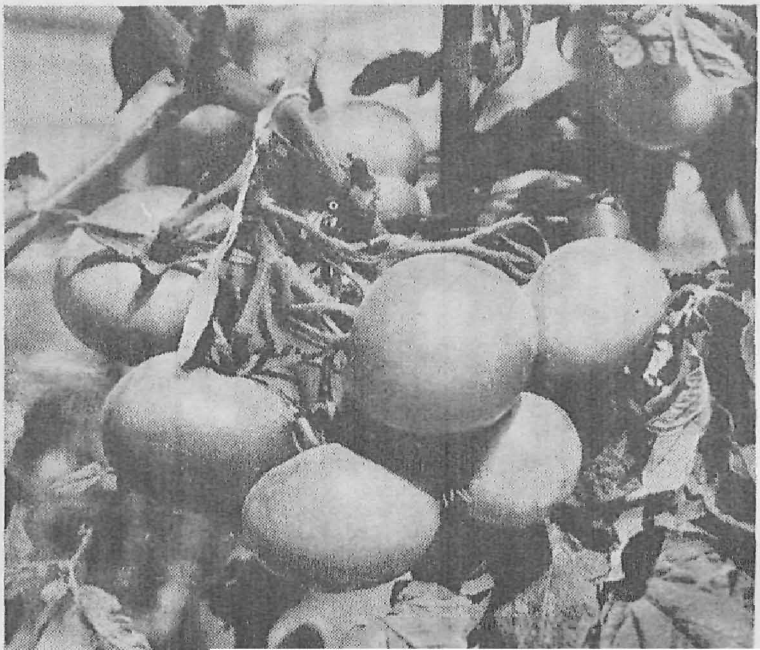


Fig. 64. Brinjal, 'Pusa Kranti'

Fig. 65. Okra, 'Pusa Sawani'

The detection of susceptible genotypes to anthracnose in jute introduced from South-East Asia led to a timely warning to Indian breeders, who avoided breeding susceptible hybrids. Control measures against the deadly disease, foot-and stem-rot of mesta, have been developed, demonstrated and adopted at the farmers' level. Pest control with pesticides and their relative efficacy have been assessed and the recommendations have been extended to the farmers' fields.

With the prices of raw jute falling, the area under jute got reduced and scientists were called upon to assure a place for jute before or after rice, wheat or potato. This object has been achieved, and 10 different multiple-cropping systems, involving food and fibre crops, both for irrigated areas and areas having assured rainfall, were evolved. Out of them, 4 systems have got established and others are being tried under national demonstrations.

The varieties of rice, jute, potato and greengram for each system have been identified at least for the tossa jute belt in India.

In ramie, it has been amply demonstrated that its plantation can be established in India and placed on a commercial footing. Information on improved varieties 'R 1452' and 'R 1411' and their agronomic requirements was detailed in a bulletin published for the planters. The all-important fibre-decorticating machine has been designed and is now in the market.

In sunnhemp, improvement proved difficult because it is a cross-pollinated crop. However, 'K 12 Yellow' was released for Uttar Pradesh and 'Chindwara' for the Jabalpur zone. The place of sunnhemp in crop rotation has been analysed and the information has been extended to farmers.

*Improved product quality.* Studies on jute-fibre bleaching have shown that bleaching with hydrogen peroxide (involving low loss in weight and strength) was the best. Resin treatments improved the wet strength and the dimensional stability of bleached jute fabrics.

A suitable dyeing process for jute fabric was also recommended for wall-covering drapery and furnishing materials. The jute cloth of improved light-fastness was evolved by using a simple chemical treatment, which would raise the export values of jute decoratives.

*Product diversification.* Studies at the JTRL on jute woollenization showed that blankets, wrappers and knitting-yarns made by mixing jute with an equal quantity of wool had practically the same properties as all-wool products. They not only gave warmth to the poor people at cheaper cost but also helped the new industries to grow.

*Blending of jute with other fibres.* In periods during which the availability of jute is scarce, the processing of substitute fibres, mesta and roselle, was recommended after thorough investigations. They are regularly used in jute mills now.

Jute-viscose rayon blending on jute machinery led to the production of high-quality decorative fabric.

*Jute utilization.* About 3 million tonnes of jute-stick goes waste annually. To improve the economy of jute cultivators and also to provide new material for industries making paper board and similar products, the jute-stick has been made into : (*i*) paper pulp of 45% yield by adopting the conventional sulphite process ; (*ii*) box-board suitable for making cartons, using high-yielding 75-80% lime-digestion process; (*iii*) newsprint and kraft paper by mechanical pulping; (*iv*) rayon-grade pulp with 25% yield (rayon yarn was made out of it); (*v*) nitrocellulose suitable for lacquer; (*vi*) flexible rotting materials in mixture with asphalt; and (*vii*) masonite-type hard particle board suitable for building materials.

*Ramie fibre.* Methods for chemical degumming and spinning of ramie fibre on jute machinery were developed. Spinning of terene-ramie blend (67-33) on staple-fibre machinery produced good yarn, which was woven and found to be quite suitable for suitings.

*Banana-plant fibre.* Banana-plant fibre, which practically goes waste, has been successfully processed on jute machinery by using a special technique. The cloth produced satisfied the ISI specification.

*Utilization of waste sisal pulp.* Methods were developed for extracting good-quality pectin and hecogenin from waste *sisal* pulp.

*Single-plant jute-ribboner.* A single-plant jute-ribboner, designed and fabricated at the JTRL has passed large-scale trials. It separates the bast of jute plant, whereas the broken pieces of jute-stick drop down. When power-driven, this prototype machine delivers about 1 000 plants/hr. Ribboning would reduce water requirement for retting and also the retting time.

*Chemical retting of jute.* To help assess the fibre quality in breeding and agronomic trials, a chemical method of extraction of fibre from fresh and preserved ribbons has been developed.

## PLANTATION CROPS

Research on various aspects dealing with the improvement of coconut has been carried out at the Central Coconut Research Station at Kasaragod (now in Kerala). It maintains a good collection of coconut

varieties. Among the recent researches carried out at the Institute, mention may be made of the semi-tall $F_1$ hybrid obtained from crosses of 'West Coast Tall' with 'Chowgat Dwarf' and 'Gangabondam', which have given a better and earlier production of nuts than each of the parents. Researches on the diseases and pests of coconut have been conducted at the Central Coconut Research Station at Kayangulam (Kerala). Recent studies on the root-wilt, a serious disease of coconut in central Kerala, have shown that a virus may be associated with this disease. It is suspected that pathogenic bacteria may also be involved in the disease complex. The Council, which took over the control of these research stations in 1966, has intensified multi-disciplinary research to solve this problem. It has also financed research schemes on the study of the *thattipaka* disease and the yellowing of coconut occurring in Andhra Pradesh and Tamil Nadu respectively.

The Central Arecanut Research Station, Vittal (Karnataka), set up by the Indian Central Arecanut Committee in 1956, was taken over by the Council in 1966. It has built up a good collection of arecanut germplasm and has done useful work on the techniques of seedling selection, varietal and interspecific hybridization and on the control of a number of pests and diseases of arecanut. The Council has sanctioned the continuation of research schemes, earlier sponsored by the Indian Central Arecanut Committee, on the 'yellowing' disease, the 'anabe' disease and the 'band' disease of arecanut in Kerala, Karnataka and Maharashtra, and also of other research schemes for the improvement of arecanut. A new high-yielding strain, 'Mangala', has also been released for cultivation.

Recently the Council integrated the three research stations at Kasaragod, Kayangulam and Vittal into a single Central Plantation Crops Research Institute. A regional station at Calicut has been established for spices under the CPCRI.

## TOBACCO

Research on the breeding of varieties suitable for flue-curing and air-curing of tobacco for chewing, cigar-leaf, *hookah* and other purposes has been carried out at the Central Tobacco Research Institute, Rajahmundry (Andhra Pradesh), under schemes sponsored by the Indian Central Tobacco Committee, established in 1945. With the abolition of the Committee in 1966, research on all aspects of tobacco has come under the ICAR.

An All-India Co-ordinated Project on Tobacco is in operation at a number of centres in the tobacco-growing States of Andhra Pradesh,

Karnataka, Tamil Nadu, Gujarat, West Bengal and Bihar. Two new flue-cured tobacco recombinants, 'Dhandhavi' and 'Kanaka Prabha', have been released for cultivation. 'CTRI Special', recently evolved, has also become popular. With the shifting of cultivation to light soils for export purposes, a regional centre in the southern light soils of Andhra Pradesh has been established at Kandukur in the Prakasam District of Andhra Pradesh. The Shimoga Centre under the all-India co-ordinated project has also been strengthened to take care of the development of the flue-cured tobacco in that area.

## TUBER CROPS

Potato is an important tuber crop, grown and consumed in India largely as a vegetable. The present Central Potato Research Institute, which became a full-fledged institute in 1949, started functioning in 1934 when a potato-breeding substation of the IARI was set up with the help of a grant from the ICAR. During the early years extensive world collections of potato varieties and species were built up at this station, especially with the co-operation of the Commonwealth Potato Expedition.

Earlier attempts for breeding varieties led to the selection of hybrids, viz. 'On 1202', 'On 1645', 'On 2236' ('Kufri Kuber'), 'PS 194', 'PS 196', 'PS 555' and 'PS 1008' for northern plains, and hybrids 'K 122', 'K 8' and 'K 9' ('Kufri Kundan') for the U. P. and H. P. hills. The Kufri varieties have come into vogue. Of them ,'Kufri Kuber', 'Kufri Chandramukhi' and 'Kufri Alankar' are early-maturing; 'Kufri Sindhuri' and 'Kufri Chamatkar' are for cultivation in U. P. and Bihar; 'Kufri Sheetman', a frost-resistant variety, is for the main crop in the north-western plains. Similarly, 'Kufri Jyoti', a late-blight-resistant variety, for the hills, and 'Kufri Lauvkar' for the Deccan plateau have assumed great popularity in the recent past. Besides, 'Kufri Dewa' has been found most suitable for the *tarai* area and hybrid 'C 2524' for the Kumaon Hills of U. P. In addition to 'Kufri Jyoti', hybrids 'F 5242' and 'F 3977' have been selected for immunity from wart and resistance to late blight to suit the Darjeeling Hills.

In view of the annual occurrence of late blight in the Nilgiris, H. P., West Bengal, etc., work has been intensified to develop varieties with the multiple-gene resistance to late blight derived from *S. demissum* etc. Consequently, 'Kufri Jyoti' and 'Kufri Jeevan' for northern hills, 'Kufri Naveen' and 'Kufri Khasigaro' for the north-eastern hills and 'Kufri Muthu, for the Nilgiris, possessing field-resistance, came into existence. Moreover, a large number of promising hybrids, viz. 'SLB/Z 405a',

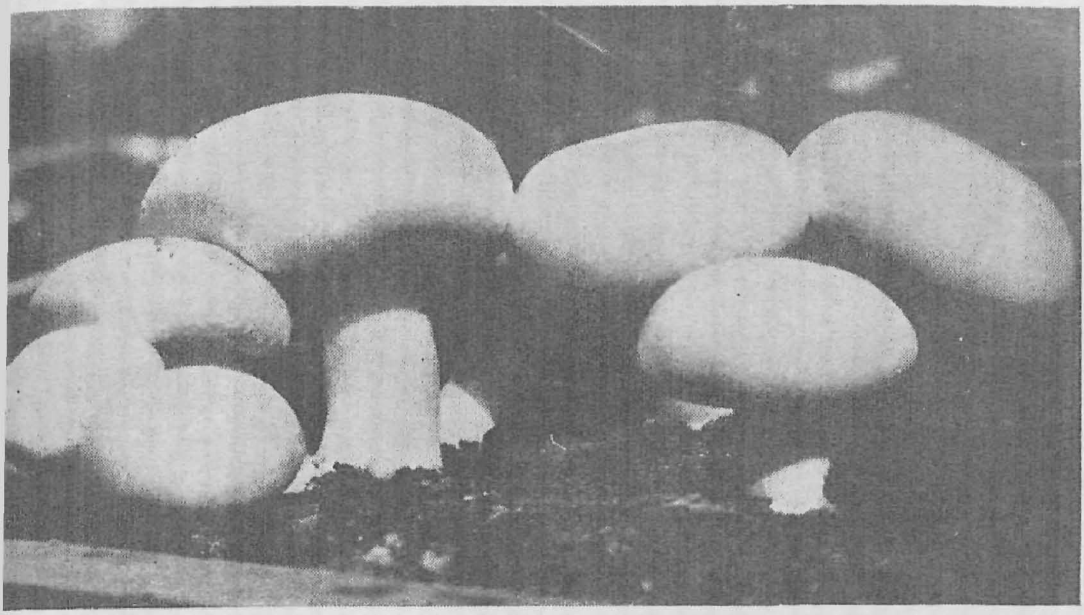
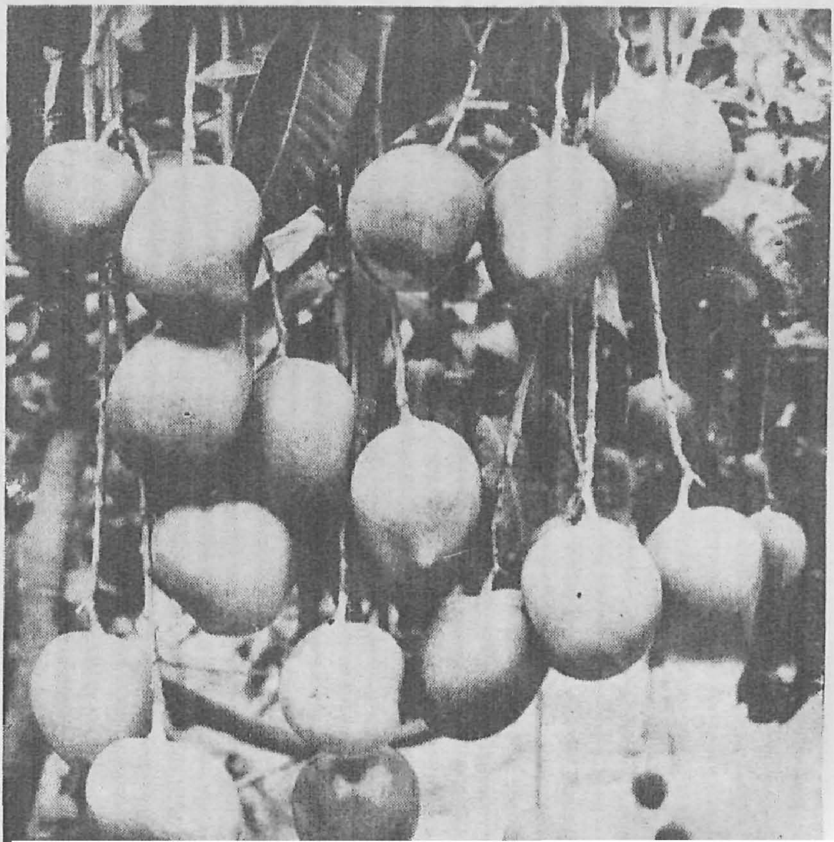


Fig. 66. 'White Button' mushroom

Fig. 67. Mango 'Langra' × 'Neelam' at the IARI, New Delhi



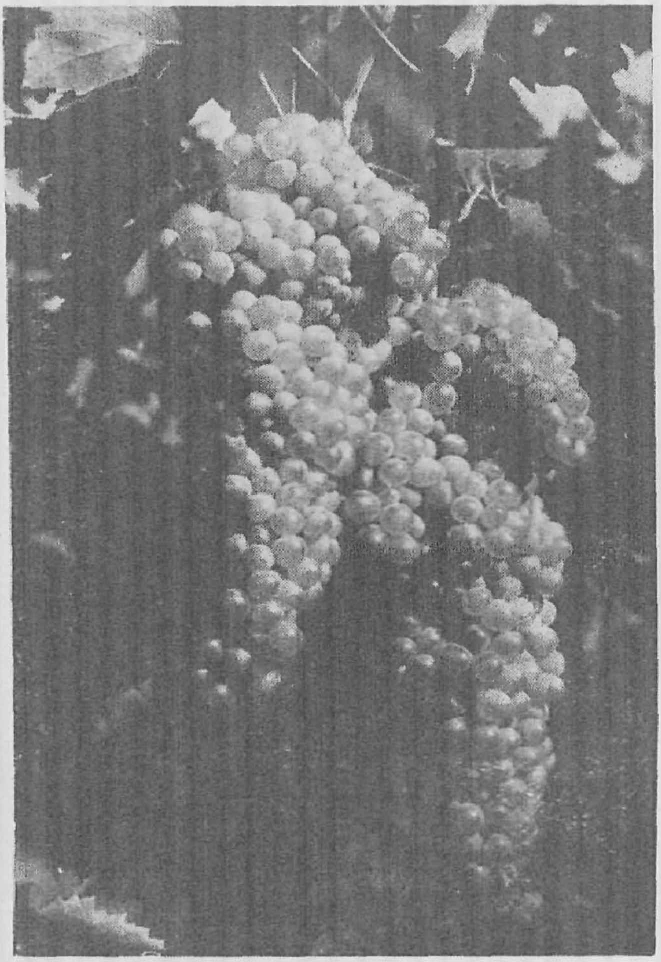
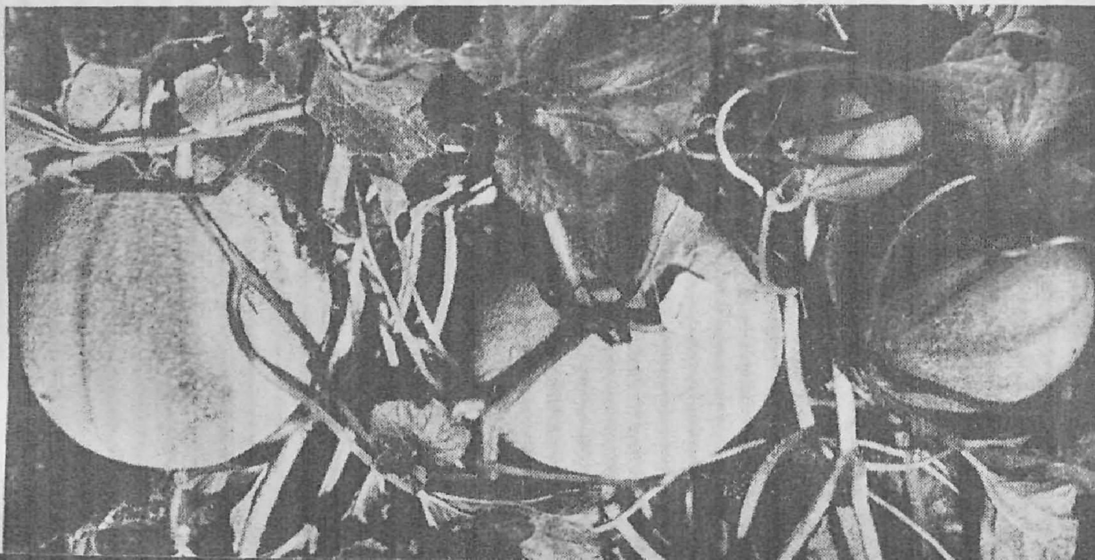


Fig. 68. 'Pusa Seedless' grape

Fig. 69. 'Arka Rajhans', a high-yielding muskmelon variety



'408' and 'VB 8', have been identified to possess a high degree of field resistance to late blight.

The ICAR has sponsored research projects for the improvement of other tuber crops also. A scheme was sanctioned for research on tapioca (cassava, *Manihot esculenta*) at the Travancore University in Kerala. In 1963 the Central Tuber Crops Research Institute was set up by the Council at Trivandrum (Kerala). It has produced some high-yielding hybrids of tapioca and sweet-potato during a short period after its establishment. A substation of the CTCRI has been established at Koraput to popularize this tuber in the tribal areas. A number of high-yielding hybrids have been released for cultivation.

## FORAGE CROPS

The Council has financed several schemes for the improvement of forage and fodder grasses and legumes. Under a comprehensive scheme, grasslands in the entire country were surveyed and classified into broad ecological types. Research was undertaken on the cytology and line-selection in a number of species of forage grasses, including *Dichanthium*, *Sehima*, *Cenchrus* and *Pennisetum*. From crosses involving different strains of Napier grass (*Pennisetum purpureum*) and *bajra* (*Pennisetum typhoides*), very productive hybrids have been produced at Coimbatore, Dharwar, Pune and at the IARI, New Delhi. The hybrid developed at Dharwar and Pune was released under the name 'Gajaraj', and the one from the IARI was named 'Pusa Giant Napier'. The Council maintains a research institute at Jhansi to give special attention to grasses and forage plants.

## CASHEWNUT, SPICES AND MEDICINAL PLANTS

The Council has so far sanctioned 15 schemes for research on cashewnut, 75 on spices and condiments, and 27 medicinal plants. Work on the improvement of cashewnut and pepper has resulted in the development of some promising hybrids which are under study. A significant advance has been made in the vegetative propagation of cashewnut by using the air-layering technique. A number of high-yielding mother-progenies have been identified in cashew. They are being rapidly multiplied to be released for cultivation. Some outstanding selections of cardamom and lemon grass, superior in quality and yield to the locals, have been released for general cultivation. The Council has formulated co-ordinated project for intensifying research to improve the major medicinal plants of the country.

## FRUITS, VEGETABLES AND ORNAMENTAL PLANTS

Research on horticultural crops was started in the country as a result of the assistance given by the ICAR for various *ad-hoc* schemes. Under the Second Five-Year Plan, the Council gave assistance for the development of eight regional horticultural research stations and 12 other horticultural substations in various agro-climatic zones of the country. In the Fourth Five-Year Plan, the Council has also launched all-India co-ordinated research projects on major fruits, important vegetables and ornamental plants.

### FRUITS

A collection of the germplasm of different kinds of fruits has been built up at the IARI, New Delhi, and at the IIHR, Hessaraghatta. Research trials on citrus conducted in the Punjab, Uttar Pradesh, Assam, and southern India have led to the development of suitable rootstocks for different kinds of citrus fruits for cultivation under different agro-climatic conditions. Rootstocks, viz. Trifoliate orange, Troyer citrange, Rangpur lime and Cleopatra mandarin, have shown resistance to *Phytophthora* and viruses. In mango, as a result of intensive breeding undertaken at the IARI, New Delhi, some hybrids involving crosses between north Indian varieties, e.g. 'Dusehri' and 'Chausa', and south Indian varieties, e.g. 'Neelum', appear to be promising for overcoming the problem of alternate bearing. 'Beauty Seedless', 'Cardinal' and 'Perlette' varieties of grapes have been found promising at Delhi, and 'Black Champa', 'Angur Kalan',' Coarna Resia' and 'Taifi Rosvi' at Hessaraghatta. In papaya, 'Coorg Honey Dew' has been isolated, which is high-yielding, requires no cross-pollination, and is good for papain production. Selection appears to be promising. In addition to the 'Dwarf Cavendish' variety of banana, another strain, called 'Robusta', has been found quite promising and high-yielding in the plains.

Methods of vegetative propagation in many fruits have been standardized. The most remarkable work pertains to the perfecting of the technique of veneer-grading in mango and guava—a detached method of grading. A method of clonal propagation of mango and guava by steeling has also been found useful in the standardization of rootstocks. The use of gibberellic acid has been found beneficial in increasing the berry size in the 'Pusa Seedless' variety of grapes.

The viruses and fungi responsible for citrus decline have been fully understood. A schedule of nutrient sprays has been worked out in Coorg for oranges.

VEGETABLES

Ever since the agricultural departments came into existence in India, the emphasis has continued to be on crop plants and the research on vegetables did not receive sufficient attention. During the forties and the fifties, however, with the sanctioning of a nucleus plant-introduction scheme by the ICAR, the evaluation of collections of indigenous material and foreign introductions resulted in the selection of nearby 30 good varieties in several vegetables. Varieties such as 'Pusa Sawani' of okra (*bhindi*), 'Pusa Ruby' and 'Pusa Early Dwarf' of tomato, 'Bonneville' of pea, along with several others, still continue to be the main vegetable varieties with the National Seeds Corporation. The improvement and seed production of temperate vegetable crops was started at the Vegetable Research Station, Katrain (Kulu Valley), with the transferring of this station to the IARI in 1955. The research on vegetables was further strengthened with the creation of the Division of Horticulture at the IARI in 1967. The seed-production technique of late cauliflower varieties has been standardized. A new tomato variety 'S 120', resistant to the root-knot nematodes, was released by the Institute. Radish 'Pusa Desi' was developed for sowing in the rainy season in the plains of southern India. Research on vegetable crops has also been started at the IIHR Hessarghatta, since its inception in 1968. A very large collection of germplasm of important vegetable crops has been made both at the IARI, New Delhi, and at the IIHR, Hessaraghatta. As a result of the breeding programme undertaken at the latter Institute, some new varieties of pumpkin, muskmelon and round-gourd (*tinda*) have been evolved and released.

ORNAMENTAL PLANTS

Scientific research in ornamental horticulture was initiated in 1957, with the starting of horticultural schemes sponsored by the Council. The work under these schemes was carried on at eight centres, one each at the IARI, New Delhi, Hyderabad, Bangalore, Shillong, Ootacamund, Coimbatore, Darjeeling and Saharanpur. Very useful collections have been built up, particularly of bougainvillaea, croton, hibiscus, roses, jasmine, orchids, cacti and succulents. The research on ornamental plants has been intensified with the establishment of a Section of Floriculture in the Division of Horticulture since 1962. Extensive work is being carried on rose breeding, which has resulted in the selection and release of 50 varieties, including 21 hybrid teas, 25 floribundas, 1 polyantha, 1 miniature and 2 climbing roses. Some of the important varie-

ties are 'Delhi Princess', 'Dr Homi Bhabha', 'Pusa Sonia', 'Shola' and 'Banjaran'. The scope for exporting roses to Europe during winter has been established as a result of the studies conducted during 1960, and the technique for pre-treating blooms and packing them has been standardized.

CHAPTER 32

# PROGRESS OF RESEARCH IN SOILS AND PLANT PROTECTION

## Soils-Soil Productivity, Water management; Agronomy; Agricultural Engineering; National Demonstrations and Operational Research Projects

THE ICAR since its inception in 1929 has financed research on problems of soils, agronomy, engineering, manures and fertilizers. The number of *ad-hoc* schemes which remained in operation up to 1977 in the disciplines of soil science and agronomy has been 144 and 298 respectively. These schemes are sanctioned to supplement the efforts of the States at conducting agricultural research. One of the earliest schemes on research in soil science relating to investigations on soil colloids was sanctioned in 1930. After that scheme, most of the research projects on soil science related to clay minerals, rapid soil colloids and clay minerals led to a new concept of the role of active aluminium in clay complexes in determining the availability of nutrients, particularly of phosphates. The physical chemists have been very active in investigating soil colloids and their relationship to the soil-fertility problem. Researches on soil salinity standardized the techniques for reclamation of saline-alkali soils in the Punjab, Uttar Pradesh, Andhra Pradesh and other States. In the Punjab the technique of cultivating *dhaincha* (*Sesbania cannabina*), rice and *berseem*, along with the use of gypsum, fertilizers and manures, was found to be the most suitable means of reclamation. Water-quality research taken up in the Punjab led to the development of the concept of rating the quality of water on the basis of the interaction of the soil, the crop and the water in a given climate.

The soil-fertility research mainly related to the investigation on organic manures and fertilizers. Before 1950, researches were mainly concerned with composting, green-manuring and the development of local manurial resources. The earliest research scheme under this group started in 1935 led to the development of the Bangalore method of composting.

Researches on the use of chemical fertilizers were not taken up till 1945 when the first scheme on the use of ammonium sulphate on the rice lands in West Bengal was sanctioned. The other important research pro-

jects were concerned with the comparing of organic and inorganic manures, oilcakes and phosphates, and with the method of applying phosphatic fertilizers. Researches on rapid soil tests were taken up at the IARI. They paved the way for the development of the soil-testing activity in the country.

## SOILS

During the Fourth Five-Year Plan, the concept of co-ordinated research projects was introduced to undertake intensive research in a co-ordinated manner. During this period research was intensified on specific problems. At present in the soil discipline research is in progress under the following major heads.

### Water-management research

Water is the key to increasing agricultural projection, but its injudicious use leads to the degradation of land, resulting in low productivity. Irrigation facilities in the country are being provided increasingly at a great cost to the nation. A sizeable area is under agriculture in the high-rainfall and temperate hill zones, where the water-use technology is badly needed for proper water management. In these tracts the existing irrigation through *kuhls* (channels) requires to be improved further for providing an efficient irrigation system. In all these cases the on-farm water-management technology has not been developed well. Recognizing this lacuna, three all-India co-ordinated research projects, viz. (*i*) the Integrated Project for Research on Water Management and Soil Salinity, (*ii*) Research on the Use of Saline Water, and (*iii*) Research on Water Management in High-Rainfall Areas and the Temperate Hill Zone, have been in operation during the Fifth Plan. These co-ordinated research projects undertake a multi-disciplinary research in a national grid of 34 research centres, representing different soil-climatic environments. During the next Five-Year Plan, the research locations will intensify water-use studies for a larger number of irrigated crops, besides rice and wheat, for screening efficient alternative cropping systems for a given quantity of irrigation water available in the supply courses. In the Sixth Five-Year Plan, a further verification of irrigation scheduling on the basis of climatic parameters will be taken up to attempt crop-irrigation forecasts for the farmers. Intensive studies for improving the efficiency of *kuhl* (channel) irrigation in the hills will be made.

### Soil-productivity Research

The optimum physical condition of the soil for proper air-water

movement and root growth is essential to the harvesting of large crop yields. Similarly, the supply of macro-and micronutrients should not constitute a constraint in exploiting the yield potentials of high-yielding seeds, with which a major thrust is being made to achieve a production breakthrough in the country. In full appreciation of the role of these soil factors in the general drive for increasing agricultural production, the Council during the Fourth Five-Year Plan has implemented 4 co-ordinated research projects in a national grid of 38 research centres, representing different soil-climatic environments in the country.

These co-ordinated research projects are: (*i*) the Micro-biological Decomposition and Recycling of Farm and City Wastes, (*ii*) the Scheme for the Improvement of Soil Physical Conditions to Increase Agricultural Production in Problematic Areas, (*iii*) the Scheme on Micronutrients in Soil and Plants, and (*iv*) Investigations on the Correlation of Soil Test with Crop Responses. These projects were suitably strengthened during the Fifth Five-Year Plan. Research on these projects or programmes will continue to be intensified during the next Five-Year Plan. The major thrust of these research projects has been towards obtaining scientific information on (*i*) biological measures for the rapid composting and efficient biogas production under different climatic conditions , (*ii*) the technology for the improvement of soil physical conditions for seedling emergence in crust-forming soils and optimum root growth in heavy soils, (*iii*) soil deficiency in micronutrients other than zinc, and the plant-deficiency symptoms in the cultivated land for early diagnosis, and (*iv*) the yield-targeting verification and efficient fertilizer use on the basis of soil-test data.

### Dry-farming Technology

Of the 139 million ha of cultivated land in the country, about 75% is rainfed. Sorghum (*jowar*), pearlmillet (*bajra*), pulses and oilseeds are almost exclusively grown under rainfed conditions. About 86, 46 and 61% of maize, wheat and rice are grown under unirrigated conditions. Even when the full potential of irrigation is realized, nearly half of the cropped land would still be dependent upon rain. Dryland agriculture is thus a major factor in the agrarian economy of India. The production from the drylands is not only low, but is also unstable. If the low production and the yield instability of dryland are not overcome, they will continue to upset the national plans. Recognizing these facts, an All-India Co-ordinated Research Project for Dryland Agriculture was started during the Fourth Plan. It started functioning in 1970. The Govern-

ment of Canada has also been rendering assistance in the implementation of this project.

The All-India Co-ordinated Research Project for Dryland Agriculture is located at 23 research centres and the Co-ordinating Cell is located at Hyderabad. At each main centre the scientists' team consists of a chief scientist, a plant breeder, an agronomist, a soil physicist and an agricultural engineer. At the subcentres the team comprises an agronomist, a soil physicist and a junior agricultural engineer.

The general areas of investigation of this Project are : (*i*) to test the efficiency of different crops and their varieties in utilizing rainfall and stored moisture, (*ii*) to find out suitable crop sequences and crop mixture and intercropping, (*iii*) water-intake studies, (*iv*) to study the efficiency of the use of surface mulches, (*v*) efficient fertilizer use, (*vi*) to study the yield potentials of crops under field conditions, (*vii*) crop substitution, (*viii*) tillage practices to increase infiltration and moisture storage, (*ix*) water-harvesting, run-off collection, storage and its efficient use, (*x*) the screening of crops and varieties, (*xi*) crop introduction and (*xii*) possible seasonal corrections for aberrant weather.

So far the project has gathered very valuable research information on the problems of dryland agriculture. Suitable dryland technology is being developed for minimizing the risk of crop production under uncertain conditions of rainfed farming.

The main components of improved production technology for dryland areas are improved varieties, moisture conservation, timely sowing, the use of adequate doses of fertilizers and weed-free cultivation. Compared with the traditional production method, the improved technology gave 150% more yield of cereal and oilseed crops, in some cases the increase being six-fold.

### SOIL MICROBIOLOGY

Research in soil microbiology has covered such important aspects as biological nitrogen fixation, the effect of rhizobial inoculants, microbial decomposition in soils, studies of microflora in the rhizosphere of soils and the isolation and identification of algae and actinomycetes in rice soils. The earliest research scheme financed by the ICAR related to the loss of nitrogen from the soils. The nitrogen-fixation studies have indicated the beneficial effect of the rhizobial inoculants.

It is now well recognized that biological fixation plays an important role in the nitrogen economy of cultivated soils. Recent developments in this area show that, besides the classical symbiotic and non-symbiotic

nitrogen fixation, associate symbiosis, particularly in cereal crops, may be of greater importance. The available data, although limited, suggest that the amount of nitrogen fixed through the asymbiotic process may well exceed the amount of nitrogen fixed through the symbiotic process.

Keeping this point in view, in April 1978 the Council sanctioned an *ad-hoc* 'co-ordinated project', which is in operation at Hissar, Hebbal, Jabalpur, Coimbatore, Baroda, Kalyani, Parbhani, Cuttack, Bangalore and New Delhi. The project will continue to operate at these centres during the Sixth Five-Year Plan.

In addition to the above co-ordinated projects, the work on soil survey, soil fertility, soil management and soil reclamation is in progress at four institutes, viz. (*i*) the National Bureau of Soil Survey and Land-Use Planning, New Delhi, (*ii*) the Central Soil-Salinity Research Institute, Karnal, (*iii*) the Central Soil and Water-Conservation Research and Training Institute, Dehra Dun, and (*iv*) the Central Arid-Zone Research Institute, Jodhpur. The brief description of each institute is given below.

### National Bureau of Soil Survey and Land-Use Planning, New Delhi

Land and water resources provide the base for our agrarian economy. The Bureau, in collaboration with the State Soil Survey Organizations, envisages to complete the reconnaissance soil survey within 10 years and the detailed soil survey within 20 years in respect of the whole country. Advanced technology of remote sensing and the use of aerial photography are to be increasingly used in completing this task. In this context the Bureau has already gone into collaboration with the Indian Space Research Organization (ISRO) to benefit from the remote-sensing technology. Besides, it has undertaken the responsibility for surveying the north-eastern region, coming within the purview of the North-Eastern Council.

### Central Soil Salinity Research Institute, Karnal

About 7 million ha is saline and 2.5 million ha in India has been affected by salts. Of these, about 4.5 million ha is alkaline. The salt-affected land remains underutilized as wasteland. Reclamation of this land and restoring of its productivity will make a significant contribution to the agricultural output of the country. Besides, salt hazards are fast appearing in the newly irrigated commands, seriously constraining

production. In recognition of these problems, a multi-disciplinary Central Soil Salinity Research Institute was set up during the Fourth Five-Year Plan. Within a short period of its existence the Institute has made various types of scientific investigations and refined the reclamation technology for adoption by the farmers. In the next Five-Year Plan efforts will be made at refining the reclamation technology for different situations, including the tidal saline areas in the coastal tracts.

### Central Soil and Water-Conservation Research and Training Institute, Dehra Dun

The importance of conserving soil and water resources for prosperous agriculture is well known. Erosion by water and wind robs us of our soil wealth. In recognition of these facts a chain of soil and water-conservation research centres has been set up since the early period of the Five-Year Plans.

During the Fifth Plan, these research centres were reorganized and strengthened as a unified set-up of the Central Soil and Water-Conservation Research and Training Institute, Dehra Dun, with the remaining six centres as its field stations. These six centres are Agra, Chandigarh, Vasad, Bellary, Ootacamund and Kota. They have undertaken research on the quantification of soil and water erosion under different conditions of cover and management. During the next Fifth Plan the research and training programme of the Institute and its centres is being further strengthened to intensify work on soil and water conservation, with emphasis on hydrology and watershed management.

### Central Arid-Zone Research Institute, Jodhpur

In recognition of the arid-land problems, the Central Arid-Zone Research Institute was set up in 1959 at Jodhpur to study different aspects of the arid-zone problems for developing technology for controlling the shifting sands and sand dunes and for the optimum utilization of the arid-zone resources to increase agricultural production. Over the years the Institute has gathered substantial scientific information on arid-land resources, ecosystem, sand-dune morphology, desert afforestation, land development, rodent control, etc.

During the next Plan the research efforts at the Institute will be strengthened further.

## AGRONOMY

A large number of schemes relating to crop production and extension have been financed by the ICAR. Many of these schemes were

concerned with the methods and practices of farming, factors influencing cropping patterns, economics of irrigation, water requirements of crops and other items of researches on irrigation. The first systematic research on the water requirements of crops was started in 1940 at Risalewala near Lyallpur (renamed Faisalabad, now in Pakistan). Most of other schemes were concerned primarily with statistics and economics rather than with agronomic aspects.

The Agronomic Project was started in 1953 as the Fertilizer-Use Project on the basis of the recommendation of Dr A. B. Stewart. In 1956 it was modified to the present form of the All-India Co-ordinated Agronomic Experiment Project.

During the Second Five-Year Plan the work was done at 34 centres and in 90 districts. The responses of crops, especially of rice and wheat, to N, P and K, along with the method and the time of their application, were studied. The relative efficiency of N fertilizers for cereals, and of P fertilizers for legumes, and their residual effects were also studied.

During the Third Five-Year Plan the work was carried out at 48 centres and in 70 districts. Additional studies on the response of crops to micronutrients, response to N, P and K, foliar versus soil application of plant nutrients and the comparative efficiency of ODDA and PEC nitro-phosphate were taken up. Besides cereals, jute was included in the study.

During the Fourth Five-Year Plan the work was continued at 45 model agronomic centres and in 55 districts. Emphasis was laid on the response of high-yielding varieties of cereals to fertilizers, both under irrigated and dryland conditions of agriculture.

During the Fifth Five-Year Plan the work was continued at 45 MAE (Model Agronomic Experiments) centres and in 52 ECF (Experiments on Cultivators' Fields) districts. The programme was reorientated to obtain information on the production potential under optimum conditions and under resource constraints, intercropping, mixed-cropping and intensive cropping systems for small and medium holdings, manurial requirement of typical crop rotations, soil test and crop response.

Various crop sequences were tried at different centres to assess the potential for foodgrain production under assured input conditions. The average of 3-year data revealed that a foodgrain production of 10 tonnes/ha/annum or more was obtained at 11 centres. The highest yield of 16.6 tonnes/ha/annum was obtained at Mangalore (Karnataka) with the three-crop sequence of rice-rice-rice. This sequence resulted in 14.8 tonnes/

ha/annum at Bhavanisagar (Tamil Nadu), where also the three-crop sequence of rice-rice-rice had been adopted. Other crop sequences that yielded more than 10 tonnes/ha/annum were rice-wheat-rice at Karamana (Kerala), rice-maize-cowpea at Bhubaneshwar (Orissa), maize-wheat-greengram at Ludhiana (Punjab), rice-wheat-greengram at Delhi, maize-wheat-greengram at the Pura Farm (Uttar Pradesh), rice-wheat at Palampur (Himachal Pradesh) and rice-wheat-sorghum at Karjat (Maharashtra).

Some other crop rotations, which included cash and fodder crops also, along with foodgrain crops, showed that a four-crop sequence, comprising the maize-potato-wheat-greengram sequence at Ludhiana (Punjab), produced 9.6 tonnes/ha/annum of grain besides 21.1 tonnes/ha of potato. Similarly, a sequence of rice-potato-wheat-cowpea fodder tried at the Pura Farm (Uttar Pradesh) yielded 8.2 tonnes/ha/annum of foodgrains, 15.8 tonnes of potato and 29 tonnes of green fodder of cowpea.

During the Sixth Five-Year Plan emphasis will be laid on the production of pulses, oilseeds, sugar and fibre crops, in addition to that of cereals. Comprehensive information on all aspects of agronomy of crop production, including the response to fertilizers, will be obtained.

## AGRICULTURAL ENGINEERING

In the early thirties research in agricultural engineering was primarily concerned with the improvement of sugarcane juice-boiling and *gur*-making techniques. With advances in agricultural engineering research in the early fifties, a scheme for the survey of indigenous agricultural implements in common use in the country was started in 1954 in all the States. The information obtained was compiled and published by the ICAR.

Studies on the designing and developing of bullock-drawn implements were taken up at the IARI, the B. R. College, Agra, the Agricultural College, Coimbatore, and at Allahabad. A project on hand-tools had been in operation at Bardoli (Surat) since 1964. Comparative trials of imported and improved agricultural implements were also made at five centres.

In 1959 a plan scheme for the establishment of research, testing and training centres in improved agricultural implements was formulated and released for adoption by the farmers. In 1966 this scheme was transferred to the States, and only four centres at Ludhiana, Pune, Mandi and Hyderabad were retained for intensive research on imple-

ments for wheat and rice areas, hilly areas and dry-farming areas respectively. Two centres at the IARI and at Coimbatore were selected for the intensification of research on the designing and developing of agricultural machines and implements suited to conditions in northern and southern India.

During the Fifth Five-Year Plan the work has been in progress under four co-ordinated projects pertaining to farm machinery, energy requirements in crop production, wells and post-harvest technology in respect of cereals and pulses.

The Scheme for Research and Development of Farm Implements and Machinery and Production of Prototypes and their Evaluation under Different Agro-climatic Conditions has been in operation at 6 centres, viz. Bhopal, Coimbatore, Ludhiana, Hyderabad, Pune and Shillong.

A bullock-drawn seed-cum-fertilizer-drill was developed at the Research-Testing and Training Centre, Pune. It has three furrow-openers for fertilizers and for seed. The range of seed-drilling rate varies from 10 to 150 kg/ha, and the fertilizer rate from 25 to 350 kg/ha. Row-to-row spacing can be arranged at 22.5, 30 and 45 cm. It requires one man with a pair of bullocks to work the drill which can be used for sowing wheat, *jowar*, gram etc., and for drilling granular fertilizers. It covers 1 to 1.5 ha in 8 hr, depending on the spacing between the rows.

A manually operated topdresser for rice was designed at Rajendranagar. It consists of a fertilizer drilling mechanism, a float fixed with a furrow-opener and a hopper for the fertilizer. A ground wheel is provided for operating the drilling mechanism. It requires two labourers to operate, one for pulling the implement and the other for controlling and balancing it.

The Scheme on Energy Requirements for Intensive Agricultural Production was sanctioned from 1971, and during the Fifth Five-Year Plan it has been in operation at five centres, viz. Ludhiana, Pantnagar, Kharagpur, Jabalpur and Coimbatore. The main achievements made under this scheme are as follows:

(*i*) Irrigation is the major energy-consuming operation for almost all crops. About 40 to 60 % of the total energy is required for lifting water, depending upon the soil type, crops and crop rotation.

(*ii*) The second major energy-consuming operation is the seed-bed preparation in heavy soils. On light soils the harvesting and threshing operations come second in energy consumption.

(*iii*) Of all the crops the upland rice requires the maximum con-

sumption of energy.

(*iv*) The utilization of tractor power in almost all mechanized farms included in the field survey samples of the 5 centres was below 60%. For the individual ownership of tractors and machinery even those of 20 and 30 HP are too big for optimal operations.

(*v*) With 200 % cropping intensities a pair of bullock can cover only about 2 ha, using indigenous implements.

The range of this limit varied from 10 to 20 ha for a 35-HP tractor and 3 to 5 ha for 8-HP power-tiller.

The Co-ordinated Project on Optimum Utilization of Groundwater through Wells and Pumps has been functioning at five main centres, viz. Ludhiana, Pantnagar, Baroda, Poondi and Hyderabad. In addition, there are three *ad-hoc* centres of research located at Jabalpur, Hissar, and Bhubaneshwar. The main projects under the scheme include studies on the development of design criteria for tube-wells and open wells and investigations on the causes of well failures and their possible remedies. Research is also under way to develop water lifts and pump suited to widely different situations.

Research on post-harvest problems of cereals and pulses was carried out under the co-ordinated schemes at 10 centres, viz. Bhopal, Kharagpur, Pantnagar, Ludhiana, Jabalpur, Udaipur, Akola, Cuttack, Raichur and Coimbatore. Some of the important problems taken up for study included the time of harvesting, drying, storage and processing.

The IDRC-ICAR Operational Research Project has been in operation at Bhopal, Cuttack, Udaipur, Akola and Coimbatore. The main objective is to evaluate under actual field conditions on the farmers' holdings and residences the results obtained under the main scheme. At all these centres the storage bins, solar dryers, harvesters and threshers are being tested.

In addition, the Council in November 1975 established a Central Institute of Agricultural Engineering at Bhopal. At this Institute the work is in progress in three main divisions, viz. (*i*) crop-production engineering, (*ii*) post-harvest engineering, and (*iii*) electro-mechanical engineering. This Institute will deal with the promotion of engineering, designing, developing and manufacturing of agricultural tools and implements suitable for Indian agriculture.

## NATIONAL DEMONSTRATIONS AND OPERATIONAL RESEARCH PROJECTS

*National demonstrations*. The national demonstrations programme was started by the Department of Agriculture (Ministry of Agri-

culture) in 1965 on a small scale for the proper demonstration of new technology of high-yielding varieties to the farmers. Later on in 1967 its administrative responsibility was transferred to the ICAR, which reoriented the maximum production per unit area and time through multiple-cropping. During the Fourth Five-Year Plan the Project continued in 100 selected districts of the country, in addition to other districts where a few demonstrations on multiple-cropping were also laid out.

During the Fifth Five-Year Plan the National Demonstrations Programme continued in 50 districts intensively.

The responsibility for conducting these demonstrations on the farmers' fields rested with the subject-matter specialists in the disciplines of agronomy, soil science, plant protection and agricultural engineering. In fact these demonstrations had been the forerunners of change and had been recognized as effective audio-visual aids for the flow of latest technology to the farmers.

The minimum yield targets for two and three foodgrain crops in the multiple-cropping sequence followed under the National Demonstrations Project had been fixed at 9 and 11 tonnes/ha respectively. The results obtained from these demonstrations helped remove the doubts of the farmers regarding the yield potentialities of the high-yielding varieties of foodgrains. Yields as high as 300 to 400% compared with the all-India average of foodgrains were obtained from the national demonstrations. By and large, in about 60 % of the national demonstrations the targeted yields of 9 and 11 tonnes/ha for two or three crops respectively were obtained.

The number of demonstrations that have been laid out since the transfer of the Project to the Council is given bleow.

| Year | Multi-crop demonstrations | Single-crop demonstrations | Total |
|---|---|---|---|
| 1967-68 | 920 | 547 | 1 467 |
| 1968-69 | 929 | 171 | 1 100 |
| 1969-70 | 1 256 | 457 | 1 713 |
| 1970-71 | 1 441 | 342 | 1 763 |
| 1971-72 | 1 671 | 250 | 1 901 |
| 1972-73 | 2 310 | 281 | 2 591 |
| 1973-74 | 2 235 | 531 | 2 766 |
| 1974-75 | 1 065 | 503 | 1 568 |
| 1975-76 | 1 043 | 321 | 1 364 |
| 1976-77 | 857 | 127 | 984 |

*Operational research projects.* Based on the experience gained from the National Demonstration Project, it was felt that there was a need to extend the concept of national demonstrations on the basis of area or watersheds. This work could be undertaken through operational research projects, involving an integrated approach to rural community problems through the co-operation of local agencies, voluntary organizations, development departments and socio-economic institutes. Hence the ICAR started a few opertional research projects for implementation during the Fifth Plan.

These projects are designed to identify the major operational problems relating to the transfer of technology from research stations to the cultivators' fields. Socio-economic, administrative and organizational problems or deficiencies in agricultural technology will be studied under these projects. The broad outlines of these projects based on scientific land and water-use planning have been worked out by agricultural universities and research institutes after discussion with the farmers to make the projects need-based. The basic concepts of the operational research projects are: (*i*) the acceptance of technology of production by the masses, (*ii*) the diversification of labour use, leading to increase in the purchasing power of the poorest section of the village community, (*iii*) scientific land and water-use planning and the upgrading of the ecological infrastructure in agricultural growth, and (*iv*) the standardization of low-cost labour-intensive prouction techniques.

Through the operational research projects it is intended to introduce the new concept of land and water-use planning into our villages. The projects would also generate more opportunities for gainful employment. The pathway chosen for development is the one that will involve an appropriate blend of monetary and non-monetary inputs.

One of the important aids to these projects is to introduce the concept of social audit in the work of transformation. This principle has been identified as a conscious attempt at improving the economic well-being of families with an annual income of less then Rs 1 000 a year, i.e. for the planning of these projects there is a built-in bias in favour of the poor sections of the rural community. At present 26 operational research projects are in operation, covering various aspects of crop and animal husbandry.

## PLANT PROTECTION

The ICAR has supported 388 *ad-hoc* research schemes on speci-

fic problems in the fields of Entomology, Plant Pathology, Nematology and Pesticides. Since the early sixties the ICAR initiated all-India co-ordinated crop-improvement projects. Each of these projects has built-in component of plant protection. The major emphasis is on the development of varieties with built-in resistance to pests and diseases. In addition, need-based testing of pesticides coupled with studies on diseases, pest cycles and cultural methods of control are also emphasized in these projects. Further, the work in various disciplines of plant protection in the crop research institutes of the ICAR is oriented towards basic research relevant to the programmes of crop improvement. Apart from these, the ICAR finances from cess funds need-based, problem-oriented, time-bound schemes on specific topics of regional and national importance to various traditional universities/State Departments of Agriculture.

Agricultural universities also have well-established departments in the fields of Entomology, Plant Pathology and at some places in Nematology and Rodent Biology. The major programmes of these universities are to tackle problems of pests and diseases which are location-specific. They also actively participate in the all-India co-ordinated projects, where the major thrust has been identification and utilization of host resistance to diseases and pests, and field-screening of pesticides. The researches conducted so far have greatly contributed to the increase of agricultural production through control and check of many pests and diseases. There is no yardstick to measure the exact gains of better crop-protection measures, unlike other inputs. The fact that occasional outbreaks of pests and diseases and epidemics have been contained and the Green Revolution has been sustained, is an adequate proof of achievements of researches in plant protection. A few examples of accomplishments that can be cited are the national wheat rust surveys, which have led to the identification of foci of infection of the three rusts and consequent realignment of varieties in the broad geographical areas to reduce damage by the rusts. Similarly, smut has been successfully contained through chemical seed-treatment in seed-multiplication programmes. Identifying varieties of rice resistant to multiple diseases and pests, and prevention of epidemics of brown plant-hopper of rice through surveillance has been a great factor in rice production. Production of disease-free potato and sugarcane, certified disease-free or cross-protected seedlings in citrus against pathogens involved in the die-back complex, and the control of apple scab in Kashmir valley are other examples.

The success achieved in the control of diseases is largely due to the

cultivation of resistant crop varieties. In insects also considerable progress on the selection of resistant varieties has been made. For this purpose a wide range of germplasm material is collected and then screened for resistance to diseases and pests. For effective screening of varieties of germplasm, hot-spot (showing chronic outbreak of pest and disease) locations provide ideal selection sieves. The information gathered through crop-improvement projects on this aspect has neen compiled in *Hot Spots of Diseases of Major Field and Horticultural Crops*. This booklet provides ready information of the ideal sites for screening against various pests and diseases, and helps to gear up the screening programmes.

Increasing concern has been felt all over the world about the poisoning and pollution of the environment due to indiscriminate use of pesticides. Further, the development of resistance to the chemicals in pests, and health hazards due to toxic residues in food chain are the other problems that affect plant protection. Hence to evaluate and resort to judicious combination of chemical, biological and other methods of insect control, the Council has taken Operational Research Projects for Integrated Control of Pests. To start with, the control of pests of crops like cotton and rice has been taken up. On cotton it is in operation in the States of Punjab and Tamil Nadu, whereas on rice in five states, viz. West Bengal, Orissa, Madhya Pradesh, Andhra Pradesh and Kerala. An operational research project on polyphagous pest, white grub, has also been implemented in Maharashtra State. These projects are based on a system approach covering a whole village with an area over 405 ha and are aimed to serve three main objectives, viz. (*i*) provide a ready demonstration to the farmers for adoption of the successful components of the programme; (*ii*) highlight the constraints in the successful implementation of pest-control operations for corrective steps in the future; and (*iii*) provide an idea of the cost-benefit ratio of control operations.

In certain areas such as biological control of crop pests, problems of nematode diseases and rodent control, where researches were being funded from the cess funds of the ICAR at several places, Co-ordinated Research Projects were formulated and implemented in 1977 through funds provided by DST. Some additional areas where co-ordinated research projects are proposed to be started in the Sixth Plan are white grubs, honey-bees, seed-borne diseases and betelvine diseases.

CHAPTER 33

# RESEARCH INSTITUTES ON VETERINARY SCIENCE AND DAIRYING

## INDIAN VETERINARY RESEARCH INSTITUTE, IZATNAGAR (1889)

ORGANIZED scientific research on the problems of livestock conservation and development in India started in 1889 with the establishment of the Imperial Bacteriological Laboratory, now known as the Indian Veterinary Research Institute. The foundation stone of the Laboratory was laid by the Governor of Bombay on 9 December 1889 at Pune. About 2.2 ha of land adjoining the College of Science was presented by a philanthropist, Sir Dinshaw Maneckji Petit, for the Laboratory.

Rinderpest or cattle-plague, as it was then called, caused heavy mortality among livestock, thus paralysing agricultural operations and resulting in famines and food scarcity. With the advent of science, organized veterinary services were started for the control and prevention of rinderpest. The congested surroundings of Pune were, however, found unsuitable for working on such a highly virulent disease as rinderpest and the laboratory was therefore shifted to Mukteswar in the Kumaon Hills in 1893.

### EARLY WORK AT MUKTESWAR

Mukteswar is situated in the foot-hills of Himalayas in Uttar Pradesh, 37 km north-east of Naini Tal and 23 km south-east of Almora. It is 75 km from Kathgodam, the rail terminus of North-Eastern Railway, and is connected by an all-weather motorable road, the construction of which was completed only in 1955. It has an elevation of 2 290-2 350 m above sea level and covers an area of 1 397 ha. Its hilly topography provides excellent isolation facilities, so essential for carrying out work on contagious and infectious diseases and for easy storage of sera and vaccines at sufficiently low temperature when refrigeration facilities were not available.

Dr Alfred Lingard joined the laboratory in 1893 as its Head, then designated Imperial Bacteriologist. He had studied bacteriology in Germany and was responsible for getting three noted Bacteriologists, Drs Robert Koch, Pfeiffer and Gaffky, to Mukteswar in 1897 to advise on the best methods for the prevention and control of rinderpest. These

experts demonstrated the procedure of immunization against rinderpest as carried out in South Africa. Work on the anti-rinderpest serum was started in the same year and the first issue of the product was made in 1899. In the fire that broke out in 1899 the record of research of the previous year as also the buildings were destroyed. The building was however restored in 1901. During 1901-1906 the Institute's products included anti-sera against haemorrhagic septicaemia, anthrax etc. A substation was also opened at Kurgaina, near Bareilly, for carrying out some experiments during the cold weather.

Dr Lingard retired in 1907 and died in 1938 in France. He lived and worked in the Himalayan forest amongst illiterate hill people, far away from the amentities of urban life, like an Indian rishi. The memory of Lingard still inspires Indian workers at the Institute to face the problems of life.

During the subsequent 43 years the heads of the Institute have all been eminent veterinarians. Lt Col. J. D. E. Holmes succeeded Lingard in 1907. Holmes expanded the scope of the work and was able to raise the income of the Institute from about Rs 5 000 in the year to Rs 74 000 in the next year by introducing a nominal charge for the biological products issued from the Institute. He also paved the way for large-scale production of sera at the substation in the plains, with the advantage of cheaper costs and more readily available transport for supplies to the field. He visualized the advisability of putting up a branch laboratory in the plains to provide such environmental facilities as were lacking in the hills. On his recommendation the Government of India purchased 306 ha of land at Izatnagar. Dr Holmes died at Bareilly in 1915. The research contributions of the Institute during his period are well documented in *A Description of the Imperial Bateriological Laboratory, Mukteswar: its Work and Products* by Holmes (1913). The production of sera and vaccines was stepped up and the demands from countries like Egypt, Sudan and Rhodesia were fully met. The income from these sources rose to over Rs 0.12 million in 1914-15 and over Rs 0.241 million in 1915-16, whereas the total expenditure was nearly Rs 0.228 and Rs 0.134 million respectively.

Dr Sheather succeeded Dr Holmes as Imperial Bacteriologist, the designation being changed to Director and First Bacteriologist. Efforts were made to improve and augment the production of sera and vaccines, besides studies on *surra*, parasitic worms, tuberculosis, bovine lymphangitis, Johne's diseases, and a first description of buffalo malaria.

Dr J. T. Edwards joined as Director in 1921. The research activi-

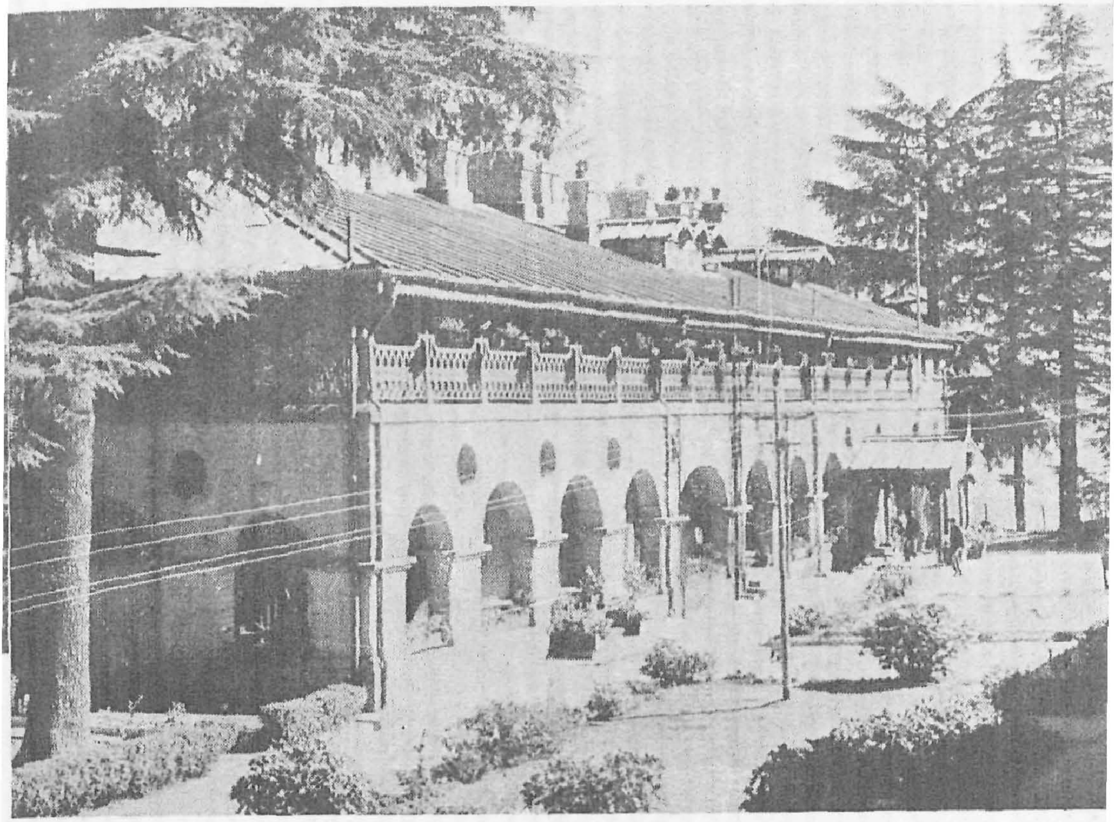


Fig. 70. Indian Veterinary Research Institute, Mukteswar Campus

Fig. 71. National Dairy Research Institute, Karnal—administrative block

Fig. 72. Central Sheep and Wool Research Institute, Malpura—main building

Fig. 73. Central Inland Fisheries Research Institute, Barrackpore—a general view of the building

ties got an impetus with a spirit of team work. For the first time a method for systematic recording of experimental data was introduced. During this period Mr Doyle was responsible for describing for the first time New Castle disease of poultry. The important research contributions are fixation of rinderpest virus in hosts other than cattle such as rabbits and goats, studies on piroplasmosis and theileriasis and improved methods of treatment of *surra*. A new direction was given to field work all over the country. Besides, more facilities were made available to the administration, and a library and social amenities for the staff. The name of the Laboratory was changed to Imperial Institute of Veterinary Research.

Closest collaboration of research was established with State departments and the ICAR when Sir Frank Ware joined as Director in 1929. The work at Mukteswar was reorganized. The addition of new sections (now Divisions) of Animal Nutrition, Poultry Research and Animal Genetics was planned during this period. The Council started financing a number of animal health research schemes at the Institute. His major endeavour was to provide a strong organization in the country to provide all-round support to livestock-improvement programmes in the country. The research attainments of the Institute are described in *A Description of the Imperial Institute of Veterinary Research, Mukteswar, and its Substation, the Imperial Veterinary Serum Institute, Izatnagar*, by Ware (1933).

In addition to the animal-health activities, attention was also paid to animal production. Divisions of Animal Nutrition and Poultry Research were inaugurated by Lord Linlithgow, the then Viceroy and Governor-General of India, in 1939.

On the appointment of Sir Frank Ware as Animal Husbandry Commissioner, Dr F. C. Mineet was appointed Director in 1939, soon after the Second World War had broken out. The tempo of research activities was maintained and a new section of Animal Genetics (now Division) was established. The Institute celebrated its Golden Jubilee in 1940 and a special number of *Indian Farming* was brought out on this occasion.

At the dawn of Independence on 15 August 1947, the Institute had already served the country for full 57 years. For the first time the development of the enormous livestock resources of the country became a national responsibility and the name of the Institute was changed to Indian Veterinary Research Institute. In 1950 the Institute celebrated its Diamond Jubilee and the ICAR brought out a special number of

*Indian Farming*, highlighting the attainments during the period 1890-1950.

RINDERPEST-ERADICATION SCHEME

The ICAR took up a pilot project on 1 October 1954 for eradication of rinderpest in a systematic and planned manner. A pilot project was taken up to cover parts of the States of Andhra Pradesh, Karnataka and Maharashtra. Under the pilot project about 16 million cattle and buffaloes were vaccinated. The vaccination coverage was around 90%. The results of the pilot project were very encouraging. In April 1956 the rinderpest-eradication programme was taken up in the entire country in a systematic manner. The programme aimed at immunizing about 80% of the bovine population. The vaccination programme was spread over in the period of Second and Third Five-Year Plans in most of the States. Then a follow-up of the programme of vaccination was taken up so that the animals that had been left over in the first vaccination campaign, and the young stock born during the interim period, were vaccinated. The campaign laid special emphasis on mass vaccination of animals not only in a systematic manner in the villages but special vaccination programme was undertaken in congregations of livestock in livestock fairs and along cattle routes.

To check the ingress of the disease from across the land border with the neighbouring countries, where the disease was known to be prevalent, 'immune zones' were created along international land borders of the country up to a width of 40 km. In addition to these 'immune zones', units called 'Vigilance units' were set up. Quarantine stations were established at the important cattle routes. Thirty-four vaccination stations were set up along international borders and 174 check posts were set up along the inter-State borders.

The mass vaccination programme under this project has drastically reduced the annual incidence of the disease in cattle and buffaloes. Before the mass vaccination programme was launched, there used to be 8 000 outbreaks, 0.4 million attacks and 0.2 million deaths in the country. This has now been reduced to 130 outbreaks, 2 800 attacks and 1 200 deaths during the first three years of the Fifth Plan. The northern States are now practically free of rinderpest. While in other States the disease no more continues to be a serious problem, the endemic pockets of the disease are being located and vaccinations are performed under Rinderpest Surveillance and Containment Vaccine Programme. In this programme freeze-dried goat-tissue vaccine evolved at the IVRI played

a crucial life-saving role. Now there are 15 biological production centres in the country which are producing Freeze dried goat tissue vaccine for use in the project. Lately a further improvement in the vaccine has been made and a tissue-culture vaccine is being produced at some centres for vaccination of cross-bred and exotic animals.

### New Divisions

In 1947 the Institute had one Division of Pathology and Bacteriology at Mukteswar and five divisions, viz. Biological Products, Parasitology, Animal Nutrition, Poultry Research and Animal Genetics at Izatnagar. In 1963 the Division of Pathology was established at Izatnagar by reorganizing the Division of Pathology and Bacteriology as Division of Bacteriology and Virology.

With the reorganization of the ICAR, the IVRI was placed under the administrative control of the ICAR on 1 April 1966.

To keep pace with the recent advances and latest trends in animal sciences research, education, training and extension education, the resources existing in 1966 were considered to be inadequate. Therefore efforts were directed towards identifying the priority needs and filling up of the gaps in every sphere for reorienting and integrating research, education, training and extension education to meet the needs of time and interest of the nation.

### New Objectives

In view of the important role that the Institute has played during the last 89 years or more and is likely to play keeping in view the recent national requirements for development of livestock health, production and technology, the objectives have been reoriented :

1 To conduct basic and applied research on all aspects of livestock health, production and technology
2 To impart postgraduate education, including extension education
3 Development of technological know-how and production of quality veterinary biologicals
4 To provide expert advice in veterinary and animal husbandry matters including diagnostic services
5 To provide technological know-how right at the farmers' door so as to improve the socio-economic conditions of the rural population.

To fulfil these aims, ceaseless efforts during the Fourth and Fifth

Five-Year Plan periods have culminated in the establishment of (*i*) 22 research divisions against 7 in 1966, (*ii*) four campuses at Mukteswar, Izatnagar, Makhdoom and Bangalore against 2 in 1966, and (*iii*) three Regional Research Stations against none in 1966. In addition, there are six special projects on livestock production research on cattle, poultry, pig, goat (for meat, milk and pashmina), sheep for mutton, and buffaloes, as participants in all-India co-ordinated projects, besides the special project on Epidemiological Studies on Foot-and-Mouth disease. An operational research project on Livestock and Fodder Improvement has also been set up at Rithoura.

Dedicated research conducted in different disciplines of animal sciences at the Institute has received international recognition and has been frutiful with the large number of proven biological products to prevent, cure and control many devastating diseases of livestock and poultry, consequently increasing the production of milk, meat, eggs and a number of animal products. Besides continuous research for making livestock and poultry industry more secure, purposeful and profitable, the frontiers of research activities have been extended to ever-broadening areas of human health, nutrition and welfare.

NEW VACCINES FOR LIVESTOCK AND POULTRY DISEASES

The sustained research in the field of animal health has resulted in the development of highly efficacious vaccines against devastating diseases of livestock and poultry. Recent researches on viral diseases have culminated in the development of (*i*) primary goat-kidney monolayer and $BHK_{21}$ cell-culture vaccine against foot-and-mouth disease, (*ii*) an effective and cheap tissue-culture rinderpest vaccine which has replaced all other vaccines, (*iii*) Flury's vaccine against rabies, and (*iv*) inactivated as well as live attenuated vaccine against sheep-pox.

Intensive researches on bacterial diseases have contributed significantly towards determining prevalence and distribution of brucellosis, leptospirosis, tuberculosis, pasteurellosis, salmonellosis, clostridiosis and mycotic infections etc. which, besides being responsible for heavy economic losses in animals, are potent public-health hazards.

In addition to characterization of many indigenous isolated bacteria and viruses, the following is the outcome of research on avian diseases : (*i*) production of antigen for the rapid diagnosis of avian respiratory mycoplasmosis, (*ii*) development of technical know-how for the production of Marek's disease vaccine, (*iii*) raising of PPLO-free flock, and (*iv*) evolving a rapid and precise diagnostic method for Marek's

disease, infectious bronchitis, infectious laryngotracheitis and chronic respiratory disease.

Studies on the systematics, morphology, biology, ecology, distribution and immunology are a pre-requisite for devising and instituting strategic prophylactic, curative and control or eradication measures against parasitic diseases. Consequently, intensive work has been carried out on these aspects of parasitic diseases, and effective measures for their control have been evolved.

The development of a vaccine against parasitic diseases is a latest trend in the discipline of parasitology. The development of radiation-attenuated vaccine against lungworm (*Dictyocaulus filaria*) of sheep and goats has been a signal achievement in application of nuclear energy for peaceful purposes. This achievement has led to extending the application of nuclear energy for evolving radiation-attenuated vaccines against other economically important parasitic diseases.

*New plant drugs.* Studies on toxicology have resulted in identifying the toxicological properties of many plants. It has been shown that even common fodders like *jowar* and star-grass, under certain conditions of growth, may become poisonous. Methods to get rid of toxic principles in such fodders have been evolved.

The richness of Indian flora and their medicinal properties is being fully exploited for their efficacy against various diseases. Recent work has demonstrated that *Cassia tora* and *Cedrus deodara* wood oil are effective in curing ringworm and various types of mange in animals.

*Fresh avenues of research.* With the generation of facilities in veterinary public health, epidemiology, experimental medicine and surgery, livestock products technology, bio-engineering and instrumentation, livestock economics and statistics, the work is gaining momentum in these spheres as well.

The introduction of genes in livestock for fast growth, early maturity, high milk yield and efficient conversion rates has resulted in developing better breeds of livestock with better productive performance. The work on physiopathology of reproduction in cattle and buffaloes has contributed to a better understanding of the pattern of oestrous cycle, intensity of heat, ovulation, puberty and sexual maturity.

The efforts for evolving superior egg-laying and broiler strains through cross-breeding have been rewarded with the development of four improved strains of both the layers and broilers. The layer strains have a potential to lay 220-230 eggs in a year, whereas the broiler strains have a potential to gain 1.5 kg of body weight at the age of 10 weeks.

The physiological and climatological studies on sweat secretion have established that none of the Indian breeds of cattle is superior to others in matter of heat tolerance. The investigations on rumen physiology have demonstrated that the sequence of events in reticulo-ruminal motility in Indian animals is none the different from that in exotic animals, but Indian ruminants exhibit a tendency towards hyper-motility. From a spleen, a slaughter house by-product, a biostimulator has been prepared. The biostimulator has been found to promote growth rate in cattle and it can replace 25% of the concentrate mixture.

Shortage of livestock and poultry feed necessitated orientation of nutrition research towards estimating nutritive value of feeds other than the conventional ones; improvement of coarse and deleterious fodder for feeding, utilization of agricultural, industrial and forest wastes as subsidiary feeds and conservation of fodder etc. Recent work has proved that sal-seed meal, a forest by-product, compares favourably with maize in chemical composition and can be utilized as a substitute for maize in rations for growing cattle and adults. Dried tomato pomace and dried *Citrus* peels can be utilized in place of wheat bran in the concentrate mixture for ruminants. Bagasse, a waste from sugar industry, on impregnation with urea can form a maintenance ration for cattle. The autoclaved, dried and powdered chicken excreta has been found suitable for partial replacement of groundnut cake.

The Institute is an active participant in all-India co-ordinated research projects on livestock production, research on development of better breeds of cattle for milk, sheep for mutton, poultry for meat and egg, goat for milk, meat and pashmina and pig for pork. All these projects have made enough headway and it is hoped that researches in these areas will considerably enhance the availability of animal products of good quality to consumers.

## NATIONAL DAIRY RESEARCH INSTITUTE, KARNAL (1955)

The National Dairy Research Institute is situated in picturesque surroundings between the Grand Trunk Road and Western Jamuna Canal in Karnal town (Haryana). The history of the Institute goes back to 1923. Following the recommendation of the Inchape Committee, William Smith, the Imperial Dairy Expert, was appointed incharge of the newly created institute—Imperial Institute of Animal Husbandry and Dairying—at the Military Dairy Farm, Bangalore, in 1923. Besides, two other farms, i.e. the Cattle Breeding Farm at Karnal and the other at Wellington, Ootacamund, served as substations. In 1925

the old Military Creamery at Anand in Bombay province was acquired and attached for training students in creamery methods. Smith retired in 1931 and Dr Z. R. Kothavalla was appointed in his place. This was a period of slump in agriculture. The Institute came under the axe of the Retrenchment Committee and the Anand Creamery was closed down.

In 1936 the Imperial Dairy Experts' Section along with Imperial Dairy Institute at Bangalore were taken from the administrative control of the Imperial Agricultural Research Institute and placed directly under the Department of Education, Health and Lands of the Government of India. This change helped the Institute in securing greater attention from the Government of India in its development.

In 1933 the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry felt the need for enhancing facilities at the Institute for conducting research and training of personnel. Consequently, the Government of India invited Dr Norman C. Wright, Director of Dairy Research Institute, Ayr, Scotland, to study the conditions relating to the development of cattle and dairy industry in India. One of the important recommendations of Dr Wright was the setting up of a well-equipped Dairy Research Institute located at a central place in an intensive dairy tract. As a follow-up to Dr Wright's report, Dr W. L. Davis of the National Institute of Dairying, Reading, was appointed the first Director of Dairy Research in 1939 with headquarters at Delhi. Further implementation of the scheme had to be shelved due to untimely death of Dr Davis, followed by adverse economic condition created by the Second World War. The office of the Director of Research together with two other research sections, Dairy Chemistry and Dairy Bacteriology, were transferred to Bangalore and merged with the existing institute there to form the Imperial Dairy Research Institute, later to be known as the Indian Dairy Research Institute on attainment of Independence in 1947.

The Institute at Bangalore was gradually developed into a research centre in the forties with the opening of laboratories in Dairy Bacteriology, Dairy Chemistry, Dairy Technology and Dairy Husbandry.

There was spurt in developmental activity following Independence. Prof. H. D. Kay, Director, National Institute of Research in Dairying, Reading, was invited in early 1947 by the Government of India to review the situation in regard to dairy education, research and development in the country. Prof. Kay reiterated Dr Wright's recommendation, and suggested early establishment of a National Dairy Research Institute, including Dairy Science College at or near Delhi.

After 8 years, beginning with the Second Plan period, it was finally decided to set up the institute in the premises of the Cattle Breeding-cum-Dairy Farm, Karnal, which had 800 ha of land, and over 1 000 heads of pedigreed cattle. The foundation stone of the Institute at Karnal was laid by the Minister of Food and Agriculture, Mr Ajit Prasad Jain, on 7 August 1955. The Dairy Chemist with a small unit of technical staff was transferred from Bangalore and posted at Karnal, to organize Quality Control Laboratory at the farm. Eventually, two other senior officers of the Institute, viz. Dairy Technologist and Dairy Bacteriologist, and main establishment of the Director's office were also transferred to Karnal. The Bangalore station became the Southern Regional Station. Two more Regional Stations, viz. Western Regional Station in Bombay and Eastern Regional Station in Kalyani, West Bengal, were established in 1962 and 1964 respectively.

In recent years the Institute has expanded considerably. It has many buildings, scientific equipment and expert staff. From an yearly budget of Rs 0.2 million in 1923-24, today it has gone up to Rs 25 million. Correspondingly, there has been a phenomenal growth in staff and other ancillary facilities. The scientific staff has dual responsibility of research and teaching. The inter-disciplinary interaction of the scientists is showing positive impact with more assurance for a stabilized research output in areas of milk production and processing.

The work of the Institute is carried out under 14 subject disciplines grouped as : (*i*) *Production group* : Genetics and Breeding, Nutrition, Physiology, Livestock Production, Fodder Production; (*ii*) *Processing Group* : Bacteriology, Chemistry and Biochemistry, Engineering, Technology, Quality Control, Human Nutrition and Dietetics; (*iii*) *Management group*: Economics, Statistics, Management and Extension. There is an educational wing, Dairy Science College, a well-equipped library and Dairy Livestock Farm and Dairy Plant. The Institute and its three regional stations function under the control of the Director, who is assisted by the Heads of Regional Stations and Heads of Divisions and sections.

## DIRECTORS

Beginning from 1923, eight eminent scientists from major areas of dairying headed the Institute as Directors. Amongst the eight Directors, five served the Institute for periods over 5 years and as long as 12 years. A majority of them had background of animal husbandry. The length of stay and specialization of the Directors have influenced

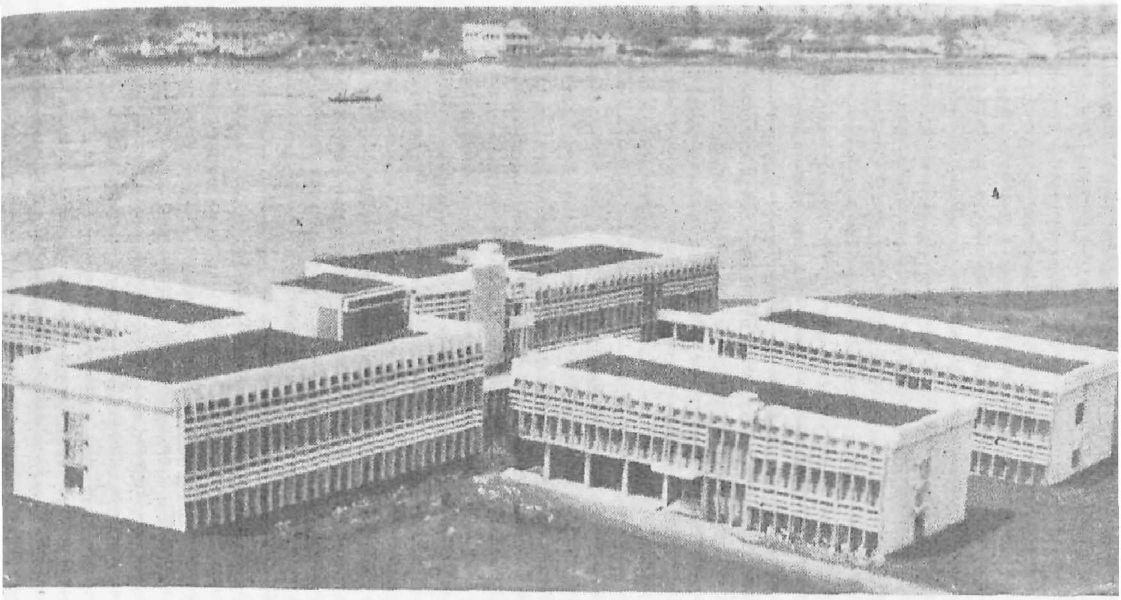


Fig. 74. Central Institute of Fisheries Technology, Willingdon Island, Cochin

Fig. 75. 'Holstein-Friesian' cow

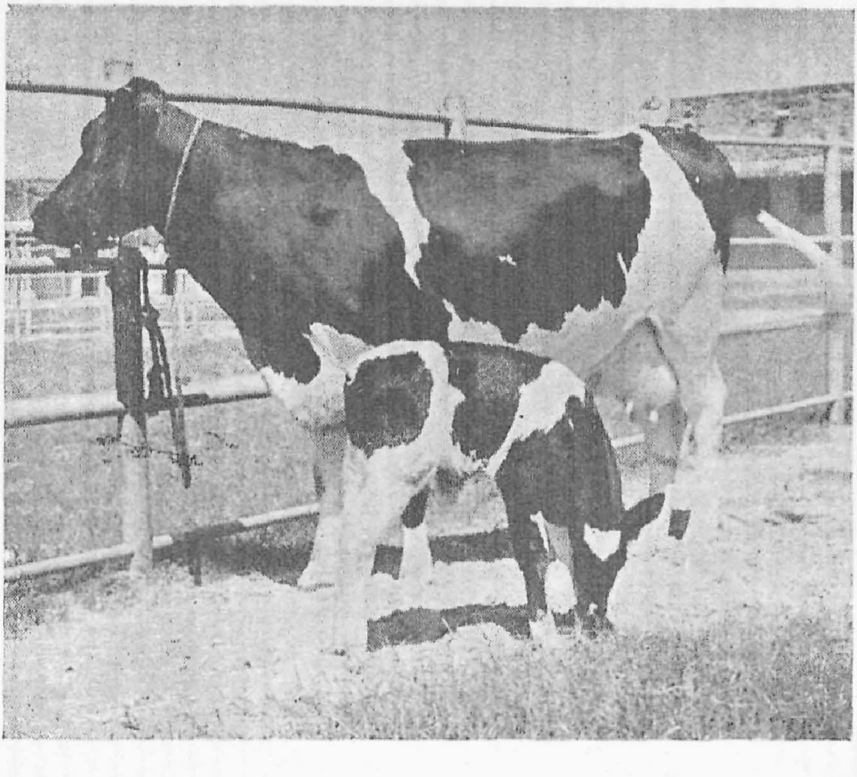
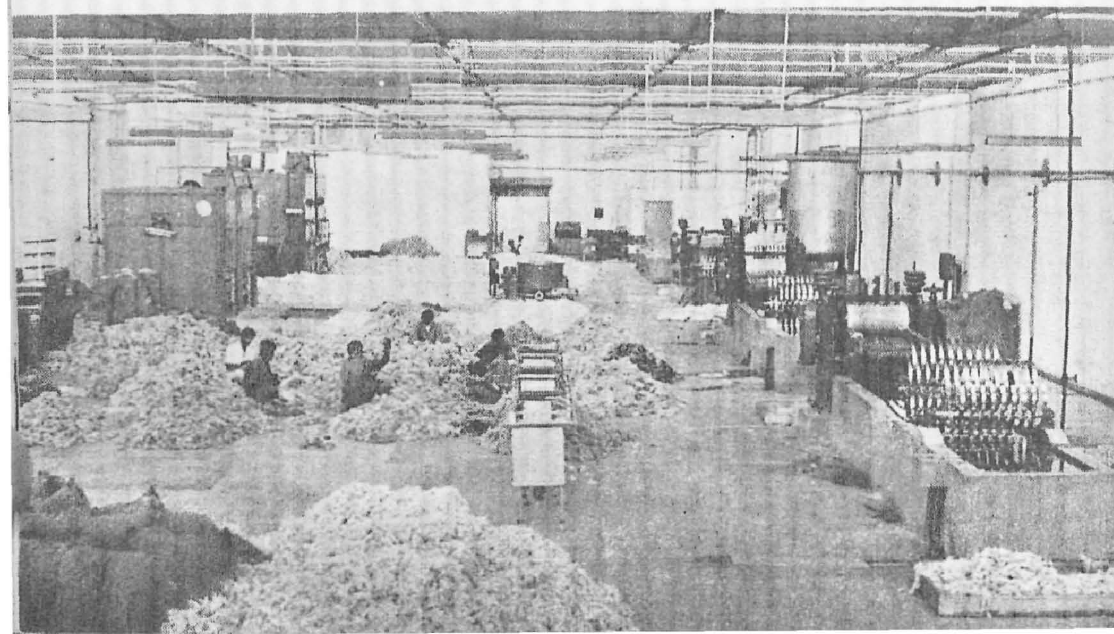


Fig. 76. Sheep grazing on oat pasture

Fig. 77. A view of the wet processing department in the Central Sheep and Wool Research Institute, Malpura



the research and educational growth at the Institute.

GROWTH

William Smith, armed with the Inchape Committee (1923) recommendations, moved the then Government of India for the establishment of Imperial Institute of Animal Husbandry and Dairying, a forerunner to National Dairy Research Institute. He was instrumental in opening of a 2-year Diploma course in Dairying in 1923 at Bangalore. The first batch of students admitted to the course consisted of 15 candidates selected out of 190 applicants from all over the country. Two other courses, (*i*) a 15-month postgraduate course (later designated Associateship in Dairying), and (*ii*) short course of practical training in dairy farming, were initiated from 1924. Pioneering work was done by the Institute in the manufacture of cheese, processing of milk, distance transport, introduction of exotic fodder crops, etc. Cattle breeding, particularly cross-breeding, with foreign bulls, also received attention.

Thirties and forties can be regarded as the gestation period, as the activities were mainly confined to the imparting of training and giving guidance to the industry and State Governments in dairy management.

In 1957 Dr K. C. Sen, who held the post of Director of Dairy Research since 1946, retired and was succeeded by Dr K. K. Iya. A programme of development and expansion of the Institute was initiated, beginning with the Second Five-Year Plan.

On the teaching side, Dairy Science College started a 4-year training course for the B. Sc. (Dairying) in 1957. The course was later bifurcated into two branches in 1961, viz. Dairy Technology, and Dairy Husbandry, to afford specialization in these areas. The postgraduate wing of the Dairy Science College was instituted in 1961. M. Sc. courses in different branches of dairying were started and facilities were provided to conduct postgraduate research work for the Ph. D. degree of different universities. On the research side efforts were made to suitably equip the laboratories and begin research work on problems of immediate interest.

Dr K. K. Iya left the Institute in 1965 and the post of the Director was subsequently held by Dr S. N. Ray and then by Dr Noshir N. Dastur for short periods. Following the retirement of Dr Dastur in 1970, Dr D. Sundaresan, Dean of Postgraduate Studies at the PAU, Ludhiana, joined as Director. Dr Sundaresan brought with him experience of education and science management. The Institute was not new to him as at one time he was holding a research position as

Cattle Breeder when he left in 1964.

The seventies can rightly be termed as a golden period of the Institute. The 50th anniversary of the establishment of the Dairy Institute was celebrated. Considerable expansion took place in physical facilities and personnel. Today there is a staff component of 250 scientific personnel, 450 in the technical cadre, 250 in the administrative cadre including ministerial staff and 1 200 in the supporting staff mostly made up of class IV staff in the farm, cattleyard, dairy plant and laboratories. Some of the major achievements are enumerated below.

DAIRY PRODUCTION

The production group of workers continued their major responsibilities centred around milk production with high-yielding dairy cattle in addition to implementing work envisaged with buffaloes and goats. The high-yielding 'Karan-Swiss' gave 3 269 litres of milk for 305 days averaged over all lactations, an improvement of 60% over the contemporary 'Sahiwal' averaging 1 988 litres for 305 days.

The new combination of 'Holstein-Friesian' and 'Tharparkar', with 50% inheritance from each, averaged 3 300 litres in 305 days in first lactation, indicating a better combination for further development.

The problem of mortality among cattle and buffalo calves was investigated at length. It was noted that infant calves with higher gamma globulins in blood had lower mortality. Based on this information, management practices have been developed, including administration of gamma globulins intravenously, to reduce calf mortality.

At the Southern Regional Station, Bangalore, extensive studies have been done on utilization of agro-industrial and marine by products for cattle-feed. The nutritive values of these products were found out and on this basis the extent to which these by-products could be incorporated in rations for livestock were developed. Percentage of incorporation of by-products like groundnut haulms, horsegram pod cells, spent coffee, rubber seed-cake, fish ensilage and the marine alga sargassum was developed.

An area of major work in production was the understanding and utilization of buffalo semen. In the basic studies, an inhibitory factor (IF) present in the seminal plasma of buffalo and cattle in relation to motility and metabolism of spermatozoa was detected. Successful dilutors have been developed, using citric acid whey, egg-yolk nitrate, and Tris for freezing buffalo semen.

Basic investigations were undertaken by radio-immunoassay in hormonal changes during the reproductive cycle in buffaloes. This led to understanding of weak heat in buffaloes and also to initiate, by administration of drugs, oestrus in buffaloes, synchronizing with ovulation for better conception.

## Dairy Processing

Work on dairy processing in the divisions of Dairy Technology and Dairy Engineering is supported by basic work in Dairy Bacteriology and Dairy Chemistry. An outstanding basic work in dairy bacteriology was the study of biosynthesis of diacetyl, which is mainly responsible for the pleasant aroma and taste of curd (*dahi*). Several new mutants of bacterial organisms have been developed, which produce the desirable flavour components. Flavour concentrates have also been developed from these organisms by adding which the flavour of products like *dahi*, yoghurt and table butter could be improved. Another area of work in dairy bacteriology was the production of acidophilus milk, which has curative property for several intestinal disorders and has great therapeutic value.

Some basic studies have been done in chemistry on synthesis of milk protein. A heat-stable factor has been detected in liver tissue of goat and rabbit during lactation, which stimulates protein synthesis by the mammary gland.

A major activity in dairy technology was utilization of whey proteins for human nutrition. Processes have been developed for isolation of proteins from caseins, rennet and *paneer* whey using various polyvalent ions, hexametaphosphate (HMP), ferric chloride, ferripolyphosphate (FPP) and carboxy methyl cellulose and gel-filtration techniques. It was possible to recover 75 to 90% of whey proteins.

The newly established Division of Human Nutrition worked in three main areas, viz. nutritive value of milk products with reference to Indian dairy products, milk and milk products in Indian diets and nutritional problems in the utilization of substandard and contaminated milk and milk products. A study on the nutritive value of substandard milks showed the wisdom in extending the supply of liquid milk to needy segments of population by using recombined and toned milk in place of whole milk.

## Dairy Management

The major work in management group was done by the faculty in

Economics, Statistics and Management Division. A highlight of this division's achievement was the economic evaluation of Indo-Swiss Cross-breeding Project in Kerala.

A socio-economic survey of dairy enterprises around Karnal indicated that a great potential for milk production exists on the premises of marginal and small farmers and also landless agricultural labourers. These groups of milk producers were contributing about 60% to the marketed surplus of milk in the Karnal milk-shed. An interesting finding was that their milk stocks were more productive and better managed than those of the affluent farmers. They also obtained higher fodder yield per unit of land.

The Operational Research Project, creating involvement of scientists in integrated and crop-production improvement programmes in 21 villages in Karnal district with a major thrust on cross-breeding of indigenous cattle through Dairy Vikas Kendras, was very successful. In about 3 years of operation, more than 1 500 cross-bred cattle have been raised. Mini dairy units with high-producing cross-bred cattle were set up on the premises of farmers at their cost.

## CENTRAL SHEEP AND WOOL RESEARCH INSTITUTE, AVIKANAGAR, RAJASTHAN (1962)

The Central Sheep and Wool Research Institute was established in 1962 with the assistance of United Nations Special Fund for conducting research on sheep and wool production and wool utilization, and for imparting postgraduate training in sheep and wool sciences. The Institute started functioning in 1962 with Dr M. V. Krishna Rao as Officer on Special Duty. Subsequently 1 620 ha of land was acquired near Malpura, about 84 km from Jaipur.

The project envisaged the establishment of the substations, besides the main research centre. One substation was planned in the Himalayas and the other in the South in Kodai Hills. The northern substation was located at Garsa in Kulu Valley, which began functioning immediately after the main station started.

During these years infrastructure for research was created. In 1964 a small flock of exotic breeds, 'Romney Marsh' and 'Southdown', were received under the Freedom from Hunger Campaign of the FAO. These flocks formed the nucleus stock at the Institute. Thereafter 350 'Rambouillet' sheep were again received under the Heifer Project from Texas, USA, also as aid from the FAO. Subsequently, local sheep mainly of 'Malpura' and 'Chokla' breeds were added. Two

small flocks of 'Romney' and 'Southdown' breeds obtained from New Zealand under the Freedom from Hunger Campaign were introduced at the Garsa Substation in 1964.

Dr O. N. Singh joined as Director of this Institute in September 1964 and the Institute thereafter initiated research projects in addition to developmental activities. Dr Singh continued up to December 1968. In the next 2 years there were three Directors in succession, viz. Mr M. L. Kohli, Dr A. Roy and Dr B. D. Patil.

The Substation at Garsa was started in 1963. Progress was made in reclamation of the land and production of forage. 'Gaddi' ewes were introduced for cross-breeding in 1965.

The Southern Substation was started at Mannavanur near Kodaikanal in Tamil Nadu. The land for the farm was acquired in 1965. Improved varieties of grass legume were introduced. Reclamation of marshes between the hill slopes was taken up to provide drainage and reduce worm infestation.

The Institute has following 12 sections, viz. Sheep Genetics, Sheep Husbandry, Grassland and Forage Agronomy, Sheep Nutrition, Sheep Veterinary, Sheep Physiology, Fibre Science, Fibre Processing, Postgraduate Training, Sheep Statistics, Economics, Library and Administration.

ACHIEVEMENTS

The significant important achievements made during this period are as follows:

Two new strains of sheep, i.e. 'Avivastra' and 'Avikalin', were evolved at the Institute. 'Avivastra' was evolved from 'Rambouillet', × 'Chokla' halfbred base through interbreeding and selection, and is being further improved through selection. At yearling age it produces on an average 2.5 kg greasy fleece weight of 20 micron average fibre diameter and 21% medullation and gives about 27% higher income through the sale of wool alone compared with 'Chokla'. The new strain is also superior in young and adult survival.

The 'Avikalin' strain was evolved out of 'Rambouillet' × 'Malpura' halfbreds through interbreeding and selection and after critical evaluation of various grades (1/2, 5/8, 3/4 and their interbreds). This new strain produces 2 kg of greasy fleece annually with 24 micron average fibre diameter and 37% medullation. The wool of this strain is suitable for manufacturing superior carpets and medium-quality apparel. The new strain is 161% superior in economic return through the

sale of wool alone compared with 'Malpura'. The performance of this strain kept on reseeded *Cenchrus* pasture with a density of 5 animals/ha along with their lambs up to weaning without and supplementary feeding has been extremely satisfactory.

The functional properties of hand-knotted carpets made out of the wool of 'Avikalin' have been tested. The Avikalin wool carpets demonstrate an exeellent appearance-retention potentialities at all stages of their use, combined with moderate compression value. The Avikalin wool in itself has been considered as an ideal carpet wool.

*Breeding 'Karakul' sheep for pelts.* The performance of 'Karakul' sheep imported from the USSR has been tested in the Division of Carpet Wool and Karakul Pelt Production, Bikaner, as purebreds and has been found satisfactory as reflected from 15 kg body weight at weaning 92% overall survival, 84% conception and around 1 kg 6-monthly greasy fleece. The quality of pelt evaluated so far has shown 44% jacket, 25% ribbed and 32% Caucassian types. The results of cross-breeding 'Karakul' with some indigenous carpet-wool breeds has been encouraging. The pelts from the halfbred produced involving 'Malpura' and 'Sonadi' have shown marked improvement and are comparable to the 'Karakul' pelt type. This technology can profitably be utilized by the sheep farmers as a new dimension for increasing their family income.

Among the other major research achievements of the Institute are the development of nutritive pastures, blending jute with wool, removal of vegetable impurities from wool, finding of new top feeds and utilization of several agro-industrial by-products as sheep feed.

Among the on-going programmes are: (*i*) breeding sheep for fine wool production, (*ii*) breeding sheep for carpet wool production, (*iii*) breeding sheep for pelt production, (*iv*) breeding sheep for mutton, and dual purpose (wool and mutton) production, (*v*) breeding goat for meat production, and (*vi*) breeding fur-bearing animals under subtemperate Himalayan conditions

EDUCATION

After shifting of the postgraduate training in sheep husbandry and wool technology from Pune, a lot of improvement was done in the courses and also some additional short-term training courses were started. The Institute now offers short-term training in Sheep Management, Performance Record Maintenance and Utilization, Artificial Insemination, Sheep Nutrition, Pasture and Fodder Development, Wool

Grading and Marketing and Wool Quality Evaluation. In addition, M.Sc. and Ph.D. programmes have also been started in Animal Genetics and Breeding, Nutrition, Physiology and Textile subjects through the collaboration of the PAU, Ludhiana; HAU, Hissar; Udaipur University, Udaipur; Agra University, Agra; Kurukshetra University, Kurukshetra (through NDRI, Karnal) and Technological Institute of Textile, Bhiwani.

CHAPTER 34

# RESEARCH INSTITUTES ON FISHERIES

## CENTRAL INLAND FISHERIES RESEARCH INSTITUTE, BARRACKPORE, WEST BENGAL (1947)

THE Central Inland Fisheries Station came into existence in March 1947 at Calcutta The main objective of the Research Station (now Institute) is to elucidate the scientific principles which could be applied for full utilization of all available inland waters of the country for maximizing fish production. Such an objective entails evolving sound fish-husbandry techniques based on modern concepts of aquaculture, acquiring understanding of the biology of food fishes, conducting investigations on hydrology and ecology of different types of fishery waters, performing research on population dynamics of fish in natural capture fishery waters like those of rivers, lakes, reservoirs, estuaries, etc., formulating artificial feeds of high conversion values and evolving feeding techniques, and developing fishery-management techniques relating to both fresh and brackish water environments. While the investigations are conducted on long-range research projects, that are of a continuing nature, in consideration of the ever-increasing consumer demand of fish in the country, due emphasis has also been laid on short-term production-oriented research projects, the solutions of which are apt to lead to rapid development of inland fisheries, especially in the field of aquaculture in rural areas of the country where both perennial and seasonal water bodies abound and which can be effectively utilized for fish production through pisciculture.

There are two aspects of the work of the Institute, Culture Fisheries Research, and Capture Fisheries Research. The former involves researches on culture of fish in impounded fresh and brackish-water bodies like ponds, tanks, *beels*, *bheries*, etc.; in the latter the data are drawn from the commercial fishing units operating in lakes, reservoirs, rivers and estuaries.

For achieving these objectives, three major divisions, viz. Fresherrter Aquaculture Division, Riverine and Lacustrine Fisheries Division tfid Estuarine Fisheries Division, were established. They are located hesBhubaneshwar, Allahabad and Calcutta, respectively, to deal with the aaanrch problems of freshwater pond culture, riverine and lacustrine eswaies and estuarine culture and capture fisheries. Freshwater Aqua-

culture Division will be shifted to Dhauli near Bhubaneshwar (Orissa) when the experimental fish farm and the laboratories are constructed.

The work of the Freshwater Fish Culture Division is conducted under the following sections at the headquarters of the Division at Cuttack in Orissa: (*i*) Pond Culture Section, (*ii*) Fish Breeding Section, (*iii*) Exotic Fish Culture Section, (*iv*) Weed Control Section, (*v*) Soil Chemistry Section, (*vi*) Frog Culture Section, and (*vii*) Fish Farm Engineering Section.

Notable contributions have been made by the Cuttack station of the CIFRI under limited field facilities, viz. a small improvised fish farm having less than 50 experimental ponds against the requirement of about 800 experimental ponds of different sizes. This limitation of the basic field facility for developmental research has been fully recognized and the need for establishing a large well-designed modern fish farm for the CIFRI was given top priority by the ICAR. For setting up the new fish farm, the Institute acquired about 144 ha of land at Dhauli in Orissa.

The Riverine and Lacustrine Division conducts research to evolve suitable measures for the development of the riverine and lacustrine fisheries of the country, including their conservation and judicious exploitation. The Division's headquarters at Allahabad was set up in 1953.

The Estuarine Division investigates into the possibilities of culturing fine fish and shell fish in brackish waters and studies capture fisheries of the brackish water lakes and estuaries of the country.

ALL-INDIA CO-ORDINATED RESEARCH PROJECTS

In mid-1971 four co-ordinated research projects, viz. (*i*) composite culture of Indian and exotic fishes, (*ii*) culture of air-breathing fishes in swamps, (*iii*) ecology and fisheries of fresh-water reservoirs, and (*iv*) investigations on riverine carp spawn prospecting and collection techniques, were initiated at the Institute. Besides, another co-ordinated project on brackish water fish farming was initiated in October 1973. In April 1974 the co-ordinated project on riverine carp spawn prospecting and collection techniques was merged with the co-ordinated project on Composite Fish Culture and renamed All-India Co-ordinated Research Project on Composite Fish Culture and Fish-seed Production.

The salient achievements of the Institute are described below.

ACHIEVEMENTS

A major breakthrough in fish seed production could be achieved by injecting pituitary-gland extract of matured fish in both Indian and exotic carps and induce them to breed in confined water. This has opened up a new line of research on selective breeding and hybridization in carps, which will help in evolving new high-yielding and disease-resistant varieties. Methods of preservation and ampouling the pituitary extract for use in future have also been developed.

Success has been achieved in inducing mullet, *Mugil cephalus*, to breed by homoplastic pituitary-gland extract. Four sets of breeders gave positive results, producing 26 000 hatchlings which could be reared successfully for a period of 10 days and one of the surviving hatchlings could be reared for 325 days.

The Institute has succeeded in inducing maturation and breeding of the marine tiger shrimp, *Penaeus monodon*, in impounded brackish water ponds in the Sunderbans. The scientists of the Institute procured completely immature specimens from freshwater ponds, induced their maturation in a brackish-water pond by eye stalk ablation and made three specimens breed in a cloth enclosure placed in a split bamboo cage installed in a creek. It is envisaged that the technique when commercialized will give a boost to Bagda culture.

Induced breeding of the air-breathing catfish, *Clarias batrachus*, has been achieved at the Kalyani Centre of the All-India Co-ordinated Research Project on Air-breathing Fish Culture. During monsoon, about 11 000 fry of *magur* could be produced in specially designed rice plots (3 m×2 m) from three sets of brood fish. This offers the possibilities of producing *magur* fingerlings by using rice fields for short duration.

The rearing of the larvae of the giant freshwater prawn, *Macrobrachium rosenbergii*, has been successfully done at the Kakinada Research Centre of the Institute.

*Nursery pond management.* A technique of rearing carp spawn to a high level of perfection has been evolved during the past 25 years. In the initial stages the survial rate was increased from 2-20% to over 50%. But in recent years the survival rate has been further increased to 60-87% at a stocking rate of 2.5 to 6.5 million/ha, using cobalt chloride (0.01 mg/day/fish) as an ingredient in the supplementary feed. In the most recent experiments the stocking rate has been further enhanced (10 million/ha), maximizing the use of nursery space. A nu-

merical yield of 6.6 million fry/ha has been obtained under such a high rate of stocking.

*Record production in composite fish culture.* Major strides have been made in raising the table-sized fish by adopting the composite fish-culture technology. The technology makes use of three Indian major carps, viz. *catla, rohu* and *mrigal*, and the Chinese carps, viz. silver carp, grass carp and common carp, stocked together in certain proportions and stocking density in scientifically managed ponds with provision of fertilization and supplementary feeding. This has enabled the attainment of extraordinarily high rates of production, the highest recorded being about 10 200 kg/ha/year—a 17-fold increase from country's average production of 600 kg/ha/year from freshwater ponds at the Pune Centre of the All-India Co-ordinated Research Project on Composite Fish Culture and Fish Seed Production.

With an idea of integrating fish culture with agriculture, piggery, duck-raising etc., involving the principles of waste utilization, investigations have been conducted under different projects with considerable success.

*Fish culture in rice fields and jute ponds.* An experiment was initiated by the Institute to establish a system of rice-cum-fish culture by renovating a rice plot (0.75 ha) at Khardah, West Bengal. For fish culture there was a trapezoid canal (0.27 ha), running all along the perimeter of the field. The canal thus constructed may enable the extension of the period of rearing of stocked fishes to a desired period, and the water may be used for irrigating the rice plot for raising additional crop of rice or pulses during summer months. The fishes were reared for the full year in this system of culture (5 months in the rice plot and rest 7 months in the perimeter canal) with provision of supplementary feeding and a production of 700 kg/ha/year was obtained, besides two crops of rice.

*Capture fisheries.* The fish and fisheries of the Ganga, Krishna, Godavari, Narmada and Tapti river systems and the Hooghly-Matlah and Mahanadi estuarine systems have been studied.

The status of the commercial fisheries (fishes and prawns) in the Sunderbans in relation to the fisheries of the adjoining areas of Bay of Bengal was determined. The spawning grounds of several commercially important estuarine fishes was delimited. The seasonal fluctuations in the plankton of the Hooghly estuary and its relationship with the hydrobiological factors, with special reference to the fisheries potential, was also worked out.

A large number of spawn collection centres for the seed of major carps and culturable brackish water fishes and prawns have been located on the river systems, estuaries and back-waters of the country. Spawn-prospecting investigations in unexploited and productive spawn-bearing stretches of the rivers were intensified since 1964, and over 60 carp-spawn collection centres established on different river systems. Efficiency of spawn collection nets has been studied and nets about five times more efficient than the conventional ones have been evolved to suit different hydrological conditions.

## Contributions of Scientists and Directors

At the time when the CIFRI was set up in Calcutta in March 1947, Dr S. L. Hora, the then Director of the Zoological Survey of India, was appointed the first Chief Research Officer. Dr T. J. Job succeeded Dr S. L. Hora as the Chief Research Officer in June 1947. It was a critical period for the country, and owing to the stress and strain of partition, lack of suitable technical personnel and equipment, the Research Station grew slowly till about the middle of 1949, when the laboratories were established in the temporary hutments of the Ministry of Defence located at the entrance of the Palta Water Works, Barrackpore, in the district of 24-Parganas in West Bengal. Dr T. J. Job applied himself to the task of organizing and equipping laboratories of the Research Station at its headquarters. As the new building at Barrackpore was under construction, the Research Station was temporarily shifted to Calcutta.

Dr H. S. Rao (August 1952-July 1954) assumed the office of the Chief Research Officer in August 1952. During his tenure a Fish Seed Syndicate was established for creating a centralized agency for supplying quality fish seed to the States and private pisciculturists. Transportation of fish fry under oxygen packing led to the reduction of mortality to only 4%. For conducting investigations on the fisheries of the rivers Ganga and Yamuna, a Riverine and Lacustrine Substation at Allahabad was established. A fishery training section with facilities to train every year about a dozen candidates in the theory and practice of inland fisheries also functioned as an adjunct of the Station since 1948. Surveys to assess the fishery resources of the important riverine and estuarine systems of the country were initiated during this period. A handbook of Fish culture, *Pond Culture in India*, was brought out, to serve as a guide to fish farmers.

Dr B. S. Bhimachar (July 1954-June 1966) succeeded Dr H. S.

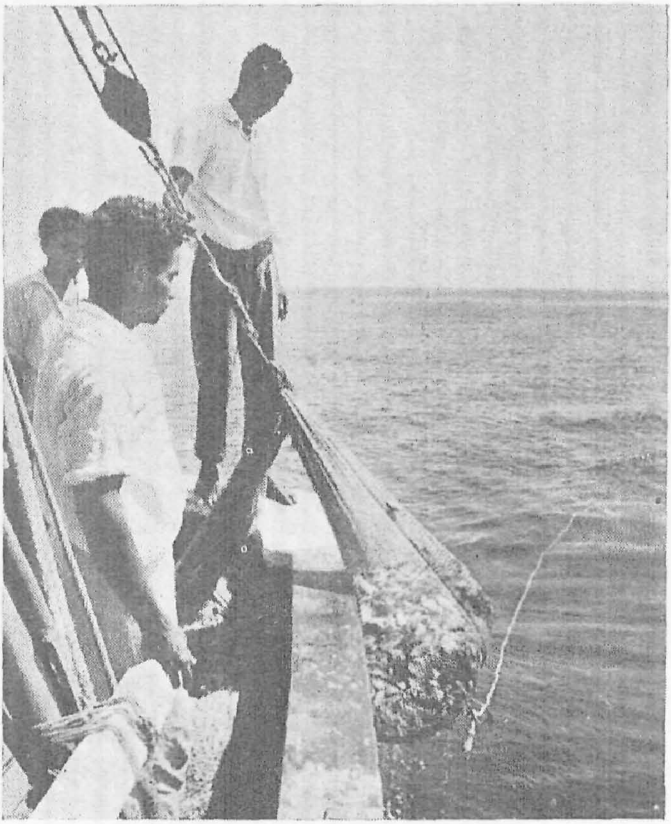
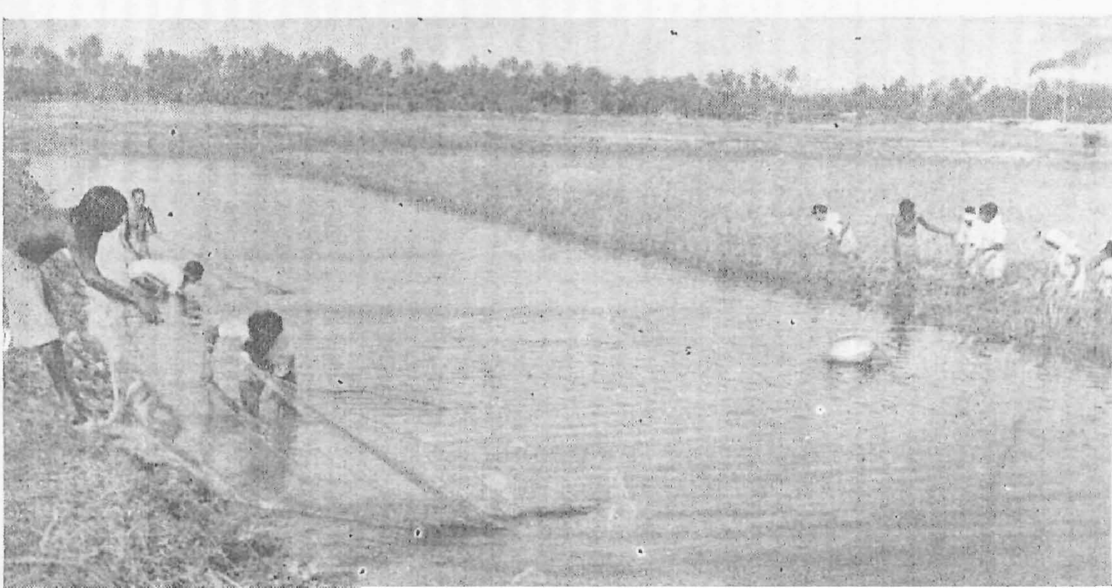


Fig. 78. Hauling up the trawl catch

Fig. 79. Netting operation in a duck-cum-fish culture pond, Krishnanagar, West Bengal



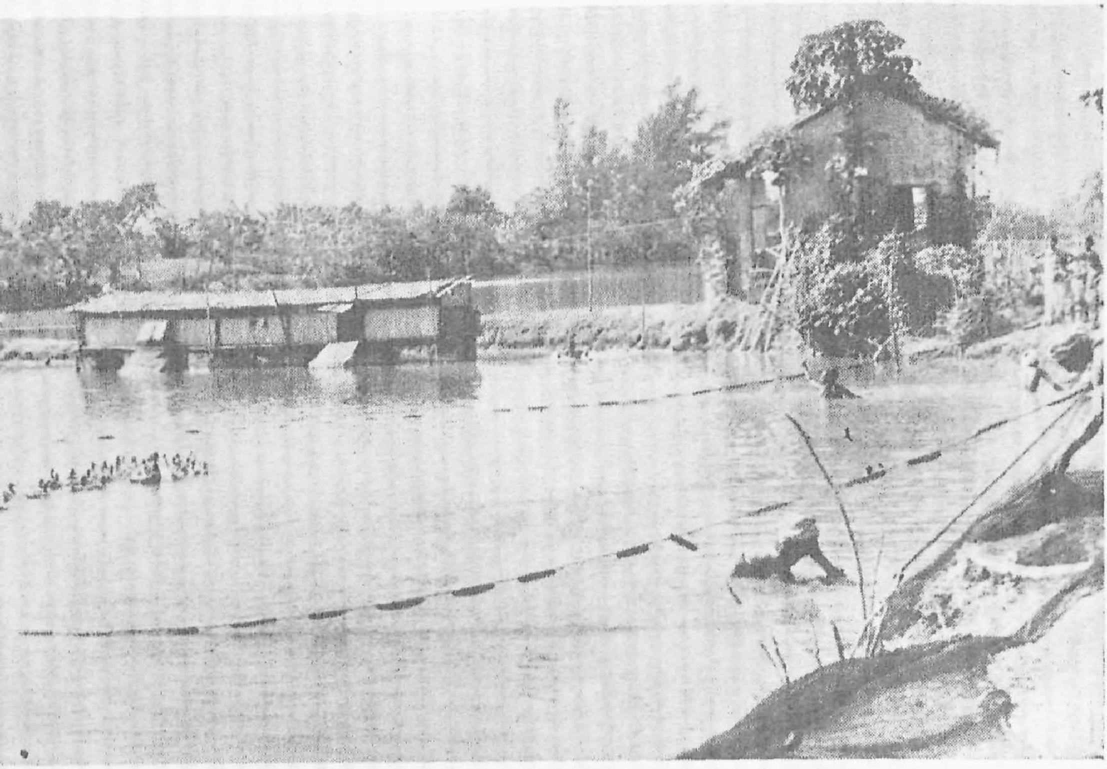


Fig. 80. Fish culture in rice fields

Rao in July 1954 as Chief Research Officer. Dr Bhimachar undertook the expansion of the Research Station by establishing more units and initiating new lines of research investigations. The Chilka Investigation Unit was established at Balugaon, Orissa, to investigate the probable factors responsible for the reported depletion of the fisheries of the Chilka lake. Fishery and fish population dynamics of commercially important fishes of the Tungabhadra reservoir were investigated, besides conducting similar investigations on the Narmada-Tapti and Krishna-Godavari river systems. Studies on the effects of industrial wastes discharged into the rivers on the fishery of rivers were also initiated. Delimitation of hilsa stocks and migratory movements of *Hilsa ilisha* were studied during this period. Induced breeding of Indian major carps by hypophyzation, production of fertile intergeneric hybrids and standardization of the methods of collection, preservation and use of pituitary glands were successfully accomplished for the first time in India during this peiod. Information on the fishery resources and status of the commercial fisheries of the Mahanadi estuarine system were gathered and sampling procedures to estimate fish production of the estuary were evolved. New permanent buildings of the headquarters and Trainees' hostel and residential quarters were completed at Barrackpore in an area of 5.2 ha on the left bank of Hooghly in 1959. Since then the Institute is housed in its own buildings at Barrackpore. Investigations carried out on the culture of Indian major carps and their compatibility with *Tilapia mossambica* and common carp, *Cyprinus carpio*, indicated the adverse effects of culturing *Tilapia* with major carps.

In 1961 the designation of the Chief Research Officer was changed to Director as also the name of Station to Institute. The Institute came under the administrative control of the ICAR on 1 October 1967.

With the retirement of Dr B. S. Bhimachar in June 1966, Dr V. G. Jhingran succeeded him as Director. He geared up the pace of expansion of the Institute and the research investigations under its different Divisions. Dr Jhingran has made significant contributions to the development of new concepts of aquaculture, which have immense practical importance and represent a major breakthrough in inland aquaculture in India.

## CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN (1947)

The Central Marine Fisheries Research Institute was established

on 3 February 1947, under the administrative control of the Ministry of Food and Agriculture. It had then temporary laboratory accommodation provided by the University of Madras. It was subsequently shifted to Mandapam Camp in 1949.

Mandapam Camp in those days was connected only by rail on the Madras-Rameswaram route. The Institute started functioning in the buildings constructed originally for the naval hospital by the Defence Department during World War II, which were in a dilapidated condition. These buildings were gradually converted into laboratories, office and temporary residences for staff at considerable expense and effort.

Subsequently a marine aquarium was built with circulating seawater facilities and on the Palk Bay side, and an experimental marine fish farm was constructed.

By early sixties, the laboratory, museum, library and residential quarters were developed.

It was realized later that in marine fisheries research all investigations have to be carried out necessarily in the areas of occurrence of the fisheries and fishes. The remoteness of Mandapam Camp from the main centres of fishing was a great handicap and this necessitated decentralization of activities and the establishment of a number of substations to tackle problems of all-India and regional importance.

The Institute came under the administrative control of the ICAR with effect from 1 October 1967. The headquarters of the Institute was transferred from Mandapam Camp to Cochin in 1970 with Mandapam Camp as a Regional Centre. Twelve Research Centres are located at Veraval, Bombay, Karwar, Mangalore, Calicut, Vizhinjam, Minicoy, Tuticorin, Madras, Kakinada, Waltair and Port Blair; and there are 31 Field Centres.

OBJECTIVES

(i) To estimate the catches of marine fishes and other animals from the seas around India throughout the year by different types of vessels and gears and to expand the effort; (*ii*) to conduct researches on marine fisheries resources to step up their production to the maximum possible extent; (*iii*) to locate new fishing grounds and untapped resources and to conduct environmental studies in relation to fisheries; (*iv*) to recommend measures for the rational exploitation of the various resources, (*v*) to develop techniques for the culture of suitable species of marine animals and plants for augmenting natural production; and

(*vi*) to organize education, extension and training programmes so as to transfer the technology to the masses.

FUNCTIONS

(*i*) Estimation and monitoring of the exploited fishery resources; (*ii*) assessment of untapped conventional and non-conventional resources by exploratory, acoustic and aerial surveys; (*iii*) strengthening of the Fishery Data Centre for collection and rapid dissemination of integrated fishery data; (*iv*) preparation of synoptic fishery maps; (*v*) studies on the population and biological characteristics of the commercial fishery resources; (*vi*) fishery forecasting; (*vii*) monitoring of fishery factors and developing a fishery environmental service; (*viii*) monitoring marine pollution in relation to protection of living resources; (*ix*) survey of seed resources and location of suitable areas for coastal aquaculture; (*x*) development of low-cost technology for the intensive culture of suitable organisms in different ecological systems; (*xi*) crop-livestock-fish culture integration; (*xii*) improvement of rural economy through blending of capture and culture fisheries; (*xiii*) studies on the economics of operation of capture and culture fisheries; (*xiv*) undertaking operational research projects, pilot projects, national demonstration programmes etc. for the propagation and establishment of mariculture enterprises; (*xv*) transfer of technology to public and private sectors through regular training programmes; and (*xvi*) fishery extension and consultancy service.

RESEARCH

The Institute has been the main agency for the collection and catalogueing the information on the diverse aspects of important fisheries. It has been compiling and analysing the data on an all-India basis and supplying such processed information to many governmental, international and business agencies. Quinquennial frame survey on marine fishing villages covering fisherfolk population, landing centres, craft, gear and other infrastructure regularly carried out by the Institute brings out the nature of changing pattern of fishing industry and its consequent impact on fishermen. This is useful for many development plans.

National Fishery Data Centre of the Institute is a repository of all fishery data, covering ecological, biological and environmental aspects. This is being developed with modern computer facilities.

The resource characteristics of our major and minor pelagic reso-

urces such as that of oil sardine, anchovies, clupeoids, mackerel, Bombay duck, tunas and related species as well as resource characteristics of important demersal resources such as prawns, silver bellies, perches, elasmobranchs etc., have been studied over three decades and very detailed information on their fishery, biology and abundances and the extent of their stock in the fishing grounds have been delineated.

The Institute has been carrying out intensive investigations on tunas, sail fishes and marlins. For the first time a comprehensive review of the Scombroid fishes of the Indian Ocean was made.

Exploratory fishing and planktological investigations carried out from the research vessel Varuna off the south-west coast of India and the Laccadive sea have helped in confirming the areas and seasons of spawning of tunas and related species; and in correlating environmental parameters and productivity of the waters with resources of tunas.

The Institute had carried out resources survey of molluscs such as pearl oysters, edible oysters, chanks, clams, mussels and cephalopods. Pioneering work done by the team of scientists specially trained in Scuba diving has helped forecast the success or failure of pearl and chank fisheries. The exploratory survey on cephalopod resources has brought to light the existence of vast resources of oceanic squid.

In collaboration with the Government of India, Exploratory Fishery Project, Integrated Fishery Project and other agencies, the Institute has charted out satisfactorily the demersal fishery resources up to a depth of 50 m in the seas around India.

Recent exploratory surveys using different gears and acoustic instruments carried out in depth some beyond 50 m have brought to light the potentially good fishing grounds for demersal fishes and shell fishes at different depths along the continental shelf edge and upper continental slope.

Exploratory surveys of the pelagic resources drew attention to the vast resources of oceanic squids, cuttle fishes, crabs, deep sea gastropods, oceanic tunas and pelagic sharks.

Pioneering contributions have been made by the Institute on various aspects of the fishery environment. Comprehensive studies on the phytoplankton, especially along the West Coast, indicated that a few species of phytoplankton accounted for the bulk on the West Coast, whereas no species account for the East Coast. The magnitude of production is many times that along the East Coast. The trend is reflected in the composition of fish catches in the respective regions.

Abundance of nutrients due to upwelling, river discharges and the lowering of temperature and salinity to optimum levels during south-west monsoon period seems to promote maximum production of phytoplankton during this period.

The magnitude of the standing crop of phytoplankton assessed by various methods indicates that the production on the West Coast is high, comparable to some fertile regions of the world, and harvest of fish could be increased substantially. Primary production studies using $^{14}C$ technique showed that the seas around India are highly productive, with a potential harvest of 3-4 million tonnes of fish.

For the first time investigations were carried out on Deep Scattering Layer. In the Laccadive Sea two distinct DSL, first between 300 and 450 m and second between 800 and 900 m, were located. The DSL is of biological origin, constituted by the aggregation of many macro-zooplankton and micro-nekton. It forms an important source of forage for pelagic fishes such as tunas, billfishes, etc.

Detailed investigations on the eggs and larvae of fishes occurring in the plankton have been carried out to locate spawning grounds and study the spawning behaviour of commercially important fishes such as oil sardine, anchovies, mackerel, tunas etc.

The work at the Institute on the biology and chemistry of seaweeds and the development of methods of extraction of agar and algin from seaweeds has paved the way for establishing seaweed-based industry in the country, resulting in savings in foreign exchange.

The Institute has made comprehensive investigations on the ancillary marine live resources such as corals, sponges, echinoderms, marine mammals and turtles.

The Institute has been monitoring marine pollution, with special reference to protection of living resources.

### Recent Achievements

Among the recent achievements is the spawning in the laboratory of many species of commercially important marine prawns, such as *Penaeus indicus*, *P. monodon*, *Metapenaeus dobsoni*, *M. monoceros*, *M. affinis* and *Parapenaposis stylifera*, and the successful rearing of their eggs through various stages right up to stocking size.

The Institute has developed low-cost technologies for the culture of brown mussels in protected bays and green mussels in the open sea, and edible oysters in estuarine area. Good production rates per unit area have been obtained in these cases.

The technology of cultured pearl production at Tuticorin has been well established and the system of multiple implantation of nuclei has resulted in increasing yield of cultured pearls. The availability of pearl oyster spats in areas like Vizhinjam has paved the way for taking pearl culture at different places. At Mandapam extensive survey of seaweed resources has been made and methods of culturing them in coir mat frames has been developed.

The Krishi Vigyan Kendra set up at Narakkal has successfully trained several batches in the practical methods of scientific prawn and fish farming.

## CONTRIBUTIONS OF DIRECTORS

Late Dr H. Srinivasa Rao was the first Head of the Institute (then designated Chief Research Officer). He was responsible for the initial organization of the Institute at Madras and subsequently at Mandapam Camp and the establishment of the substations at Bombay, Karwar, Calicut on survey centres along the East and West Coasts of India. Special emphasis was given for the first time on fishery survey for the collection of catch and effort data on an all-India basis for marine fisheries. More intensive investigations on pelagic fisheries, particularly sardines and mackerel, were initiated by him along with work on marine biology and in-shore hydrography.

Late Dr N. K. Panikkar served as the Director from 1951 to 1957. He was responsible for the future growth of the Institute at Mandapam Camp and the establishment of the substations at Waltair and Mangalore. Under his guidance the staff of the Institute undertook an all-India samples survey of fish landings, collection of exploratory fishery data by participation in deepsea fishing operations, made significant contributions on the fishery and biology of oil sardines, mackerel, perches, marine prawns and squids. Besides, valuable contributions were made to the knowledge of near in-shores hydrography and plankton of the south-west coast of India and Gulf of Mannar. His major interest was in the field of fish and shell fish physiology.

Dr S. Jones served the Institute as the Director from 1957 to 1970, coinciding with the Second to the Fourth Five-Year Plans. During his tenure the establishments at Tuticorin, Vizhinjam, Veraval, Kakinada, Port Blair and Minicoy came into existence. Under his guidance the Institute was able to make valuable contributions on the resources of oil sardine, mackerel, Bombay duck, tunas and billfishes, prawns and other demersal resources. Significant contributions were also made

on the exploited marine fishery resources and the results of the exploratory fishing by research vessels such as R. V. Varuna. Environmental studies and oceanographic investigations were greatly strengthened.

Dr S. Z. Qasim served as the Director of the Institute in 1971-73. During this period the country's marine fish production crossed the 1 million tonne mark. He initiated and vigorously pursued investigations on energy transfer in different trophic levels in selected ecosystems. *The Indian Journal of Fisheries* was brought up to date chiefly through his efforts.

Dr E. G. Silas, the present Director, took charge of the Institute on 25 June 1975. During his tenure a number of inter-organizational or funded projects having an integrated approach for coastal rural development through sea-farming and integrated crop-livestock-fish systems have been initiated. The research infrastructure has been strengthened by taking up the construction of a modern 107' research vessel costing Rs 17.5 million. Through his efforts the construction of a well-equipped laboratory and office buildings for the headquarters at Cochin has been taken up at a cost of Rs 31.2 million. Steps have been taken to provide similar laboratory, farm, residential quarters and research vessel facilities for the research centres of the Institute.

### CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY, COCHIN (1957)

The Central Fisheries Technological Research Station, as the Central Institute of Fisheries Technology was named at the time of its inception, was established at Cochin, in December 1957, under the Department of Agriculture of the Ministry of Food and Agriculture. The Institute was established with a nucleus staff for research and development activities in fishing craft and gear. The Institute acquired its present name in 1962.

The establishment of the Institute was the direct outcome of the zeal and enthusiasm of Mr G. K. Kuriyan, who was appointed by the Ministry as Special Officer for the purpose. The first mechanized fishing boat, 'Pable', which term subsequently became the synonym of mechanized fishing boat in the country, was built by Mr G. K. Kuriyan, working in Madras as counterpart to the FAO Experts: Mr Paul B. Zeiner, Naval Architect, and Mr G. S. S. Illugason, Gear Engineer.

Mr Kuriyan held additional charge as Director of the Institute during 1969-70. He became the regular Director of the Institute in September 1974 and is continuing in that position.

A Division of Processing was organized in the Institute in 1958. The Division subsequently was put under the charge of Dr V. K. Pillai, one of the pioneers of fish processing and quality control research in India. The credit for evolving quality standards for the various types of processed products like frozen and canned prawns, frozen lobsters and froglegs, shark fins and fish maws, dry prawns and a variety of dry fish products goes to Dr Pillai. These quality standards formulated by him in association with the Indian Standards Institution served as basis for the quality-control inspection of fish products for export from India. Dr Pillai was responsible for organization and working of the voluntary pre-shipment inspection in 1964, and later compulsory inspection in 1965. The scheme of compulsory inspection of fish products for export was operated by the Institute under his leadership until it was transferred to the Export Inspection Council of India in 1969. The rigid quality-control measures enforced on the Indian-processed fish products for export were responsible for boosting the image of the Indian products in world markets and thus enhancing the volume and value of the exported commodities year after year. At present India exports products worth Rs 2 500 million every year. The Government of India established the Marine Products Export Development Authority at Cochin in 1971 to take care of the exports of marine products from this country. The sad and sudden demise of Dr V. K. Pillai in December 1972 has been an irreparable loss to the Institute.

At the time of establishment of the Institute, the Head of the Institute was designated Chief Research Officer. The designation was changed to Director in 1961 and Dr A. N. Bose, who was holding the post of Professor of Food Technology and Biochemical Engineering in Jadavpur University, Calcutta, was appointed the first Director of the Institute. The Extension, Information and Statistics Division of the Institute and units at Bombay and Calicut were organized by him. The Institute was slowly but steadily expanded under his Directorship by adding staff and facilities. The proposal for a permanent building for the Institute in Willingdon Island was made by him.

CHAPTER 35

# PROGRESS OF RESEARCH IN ANIMAL SCIENCES

LIVESTOCK play an important role in the economy of the country and contribute nearly Rs 32 billion (1970-71) to the national economy. Livestock-keeping centres around the small cultivator. To the large majority of farmers livestock raising is a subsidiary occupation to crop production. The cultivator has meagre resources, he lives on a small holding of about 2 ha, and he has two or three animals. Crop raising and rearing of animals go hand in hand in this country. In view of the importance of animals in farm economy, the Council has promoted research in animal sciences. In 1931 steps were taken to compile statistics on the performance of different types of cattle and buffaloes maintained at the organized farms. Heavy losses due to contagious diseases had not only reduced livestock production but had also adversely affected agricultural operations which are dependent on animal power. In 1931 the Council sanctioned a number of schemes to investigate diseases in different States, and disease-investigation units were established. These units provided the information necessary for discovering effective control measures against important diseases.

Since then a comprehensive set-up for animal sciences research has been developed in the country. There are Central and State Research Institutions that have been set up to undertake research on various aspects of livestock production, i.e. breeding, nutrition, management, health, forage production and processing technology. The Central institutes, devote themselves primarily to fundamentalandapplied research, the State institutes undertake research on problems of regional and local nature. In addition, the agricultural universities also conduct research on various aspects of animal production. In the institutes, animal sciences research is conducted under the all-India co-ordinated research projects and *ad-hoc* research schemes.

## CATTLE, SHEEP AND POULTRY BREEDING

### CATTLE

In 1928 the Royal Commission on Agriculture laid stress on the production of draught cattle, stating that in attempting to secure more milk from the draught type, there was real danger of losing the draught qualities. It was also pointed out that the production of dual-purpose

cattle may be limited to districts where feeding conditions were good. In 1937 Dr Norman C. Wright, a dairy expert from the UK, recommended the introduction of milk in draught breeds without bringing about any deterioration in draught quality. He advised against cross-breeding and laid great stress on the environmental conditions under which the animals were kept. Earlier research on cattle breeding had been therefore directed towards improving the milking quality of the indigenous breeds. To achieve this objective, the Council undertook in 1937 an enquiry in selected breeding tracts to determine the actual levels of production of the various breeds. In 1939 the enquiry was followed by systematic programme of defining the characteristics of various breeds to assist in the selection programme. Breed definitions of 25 breeds of cattle and of 7 breeds of buffaloes were finalized through schemes financed by the Council. Further, to ensure the improvment of breeds, a programme of pedigree registration was taken up in 1941 in respect of breeds of all-India importance. A cattle-breeding policy for the country was laid down. Its main feature was to develop dual-purpose cattle, increasing the milk-yielding capacity of the indigenous breeds, without impairing their draught quality. A long-range research programme to evolve dual-purpose 'Hariana' cattle was started in 1941 in the Punjab. A similar programme in respect of the 'Kangayam' breed of Tamil Nadu was taken up in 1942.

As planning of breeding programme had to be based on the information on the genetic traits of indigenous breeds of cattle and buffaloes, the analysis of breeding and production data obtained from a number of cattle-breeding farms was made to find out the estimates of heritability of various characteristics. This provided a sound basis for formulating future breeding programmes.

Selective breeding was being practised in areas covering well-defined breeds. In non-descript areas, however, a programme of upgrading with selected Indian breeds was undertaken. A research programme on the comparative study of selective breeding of local cattle and of upgrading them with improved breeds was taken up in a number of States through a scheme started in the early fifties. Selection has been carried out to bring genetic improvement in different cattle breeds in Government and selected private cattle-breeding farms. Some of the important herds in which genetic improvement has been achieved by selection are those of the NDRI, Karnal ('Sahiwal', 'Red Sindhi' and 'Tharparkar'), IARI, New Delhi ('Sahiwal'), Allahabad Agricultural Institute, Allahabad ('Red Sindhi'), Livestock Research Station, Hosur ('Red Sindhi'

and 'Kangayam') and the Gujarat Agricultural University, Anand ('Kankrej').

Genetic studies on various characters like heritability, age at first calving, calving interval etc. have been made on the several important herds of different breeds.

Whereas selective breeding did result in some improvement in milk production, this was a long-range process. At the same time there was evidence of accelerated production through cross-breeding, which was started earlier by the Military Farms Department. The production data of various grades of progeny, ranging from 1/8 to 7/8, were compiled in 1939 by the ICAR. However, since the national breeding policy was to develop a dual-purpose animal, no serious effort was made in research on cross-breeding. For the first time the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry of the Council recommended cross-breeding in 1953 on a pilot scale in the hilly and heavy rainfall areas. The objective of this programme was to increase milk production by crossing exotic breeds with indigenous cattle, and to replace the existing large number of uneconomic stock by high-yielding cross-breds. Thus cross-breeding of non-descript cattle with 'Jersey' bulls was initiated in 1955 under a research scheme in the rural, hilly and heavy rainfall areas in the States of Kerala, Andhra Pradesh, Karnataka, Assam, Bihar, U. P. and Himachal Pradesh. Under this research programme, it was intended to find out the optimum level of exotic inheritance that would enable the cross-bred progeny to produce its best under the existing environmental conditions and to study other allied problems concerning the cross-bred animals. There was two-fold to three-fold increase in the milk yield in cross-bred animals of the first and second generations. The cross-bred progeny matured earlier and had a shorter inter-calving period under proper management and environment.

The results achieved through this pilot programme brought about a revolutionary change in thinking amongst the cattle-breeders in the country. A Working Group on Cattle Breeding Policy in 1963 recommended the adoption of cross-breeding not only in the hilly areas, but also in other places where there were facilities to rear and maintain high-yielding milch cattle, and where there was need to augment milk supply. The Scientists Panel on Animal Husbandry set up in 1965 specifically recommended breeding methods to be adopted for a rapid increase in the milk-producing capacity of the cattle, and pointed out that with selective breeding it might take 70 years to double the milk yield in a breed, whereas with cross-breeding this achievement might be possible

in one generation. It was also suggested that cross-breeding of non-descript cattle with exotic breeds might be given a start immediately, and an attempt be made simultaneously for evolving new breeds of cattle suitable for different agro-climatic conditions through cross-breeding and subsequent inter-breeding and selection.

During the Fourth Five-Year Plan a Co-ordinated Research Project on Cross-breeding was taken up and this is being continued in the Fifth Five-Year Plan. Its object was to evolve a breed of dairy cattle from the local breed by cross-breeding that would be suitable for specialized dairy farms, intensive milk production areas and other areas of commercial milk production. The animal to be so evolved should give a minimum milk production of 2 000 kg of milk per lactation with a herd average of 3 000 kg of milk per lactation and a fat test of not less than 3.5%. To achieve this objective, different crosses of indigenous animals with exotic breeds, like 'Jersey', 'Brown Swiss' and 'Holstein-Friesian', are being studied at the IVRI, Izatnagar. At the HAU, Hissar, 'Hariana' breed—being a local animal—has been taken up for this study. At the Mahatma Phule Krishi Vidyapeeth, Rahuri, and the JNKVV, Jabalpur, 'Gir' breed is being used for crossing with exotic breeds. 'Ongole' breed is being used at the APAU, Rajendranagar, at Lam farm. The results of research under similar programmes being conducted at Livestock Research Station, Haringhatta (West Bengal), are also co-ordinated with the Project. Different combinations are being studied for their growth rate, age of maturity, age of first calving, milk production, calving interval, etc. Though the programme is of long-term nature, encouraging results have been obtained at different centres.

Cross-breeding research work of 10 years at the NDRI, Karnal, led to the development of a new strain of dairy cattle, 'Karan-Swiss', in 1972. It possesses exotic inheritance from 'Brown Swiss', and 'Zebu' inheritance from 'Sahiwal' and 'Red Sindhi' breeds. The average milk production of this strain is about 3 000 kg per lactation in 305 days.

The breeding programmes for the improvement of cattle and buffaloes were handicapped owing to the shortage of superior breeding bulls. To overcome this handicap, the Council in 1942 sponsored research at the IVRI for the adoption of artificial insemination under Indian conditions. This was followed by the establishment of Regional Stations at Calcutta, Patna, Montgomery (now in West Pakistan), and Bangalore to recommend a suitable technique and to study the organizational aspects of the large-scale application of artificial insemination. These investigations resulted in the development of various diluents and in the

selection of techniques for adoption in artificial insemination. At present the breeding in the intensive cattle-development blocks, key villages and most of the organized farms is through artificial insemination. The technique of deep-freezing semen of superior sires has also been adopted. Research on various aspects of artificial insemination such as cytomorphology and physiology of spermatozoa, semen biochemistry, semen extenders, effect of nutrition and exercise on sperm production, seasonal effects of reproduction of Indian farm animals etc. has been carried out at the IVRI, Izatnagar, and NDRI, Karnal. In sheep, artificial insemination on a limited scale is being practised in some of the countries.

*Buffalo.* The buffalo is an important dairy animal in India. It provides the farmer with milk and ghee. One characteristic feature of the buffalo milk is its high fat content, e.g. about 7% on an average compared with 4 to 5 % in the milk of Indian cows. The higher fat content makes the buffalo more economical than the cow as the producer of butter and ghee. Out of seven well-defined breeds of buffaloes, 'Murrah' is in more extensive use throughout the country. A co-ordinated research project has been taken up in the Fifth Five-Year Plan for improvement of milk production of buffaloes and for improvement of their feed-conversion efficiency. The centres of the Project are located at Ludhiana, Udaipur, Dharwar and Karnal.

Indian buffaloes, particularly those in the dry northern region of the country, are seasonal breeders, because during the summer months (April to July) they do not show normal oestrus and as such most of them are not bred during that period. Physiological studies have indicated that such a condition is mainly due to photo-sensitization. If shelter is provided and water is sprinkled on the buffaloes during the day, the animals show normal oestrus and can be bred throughout the year.

## SHEEP

Sheep is another important livestock species in the Indian agricultural economy. It provides meat, wool, manure and also milk. Sheep is the most appropriate livestock species for utilization of sparse vegetation in arid and semi-arid areas with marginal and submarginal lands unfit for agricultural production. Indian breeds of sheep are able to survive prolonged periods of drought and semi-starvation and to travel over long distances for obtaining forage and water. They are less prone to hazards of tropical heat. They are non-seasonal breeders, and thus have higher reproductive rates compared with the seasonal breeders.

The majority of the Indian sheep produce coarse-type wool, with

an average clip of less than 0.5 kg. The Council, from its very inception, initiated programmes for evolving sheep with superior wool through selective breeding and cross-breeding with 'Merino'. One such programme of cross-breeding 'Bikaneri' sheep at Hissar resulted in the development of a fine-wool breed called 'Hissar Dale'. In 1940 studies on the attributes of Indian wools were initiated at several centres in the country which provided basic information on the quality of wool of the indigenous and cross-bred sheep. Techniques for the evaluation of Indian wools were also developed.

With the increase in demand for fine wool by the mills in 1952, a research programme for the improvement of sheep and wool on a regional basis was taken up at several stations, to develop a strain of sheep which would yield heavier and finer fleece. Under this programme, cross-breeding with 'Rambouillet'was undertaken inhilly areas, whereas in the plains emphasis was on selective breeding. Cross-breeding was also recommended in the Deccan plateau and the Nilgiri Hills. The cross-bred progeny with exotic inheritance showed better growth rate and four-fold yield of wool of uniform quality, besides being suitable for the manufacture of apparel.

The researches conducted on a regional basis showed that cross-breeding with 'Rambouillet' could be taken up in the temperate region. Further, through this programme it became evident that the quality of wool could be improved. The cross-bred progeny produced double the quantity of wool with fine and uniform fibre. Realizing the importance of the sheep and wool industry, the Council established a Central Sheep and Wool Research Institute at Malpura (Avikanagar, Rajasthan) in 1962.

This Institute is engaged in research on fundamental and applied aspects of sheep and wool production and wool utilization, including research on various aspects of sheep husbandry, nutrition and physiology. A co-ordinated research project on sheep for wool and mutton has been taken up. The object of the Project is to evolve a superior type, producing fine-quality wool, and to evolve a new type of mutton sheep with high genetic potential so that animals may attain a body weight of 30 kg at 6 months of age. In addition, extensive studies on heritability of wool, correlation between potasium types and production traits, correlation between haemoglobin types and economic characters have been made.

## POULTRY

Till recently poultry was largely kept on free range, allowing the

birds to feed for themselves. Investigations were taken up for the first time to study all aspects of poultry husbandry through a scheme sanctioned in Bombay in 1936. Since poultry diseases were common and caused heavy losses, it was decided to develop a disease-resistant *desi* strain with higher egg-producing capacity. In 1944 a programme of improvement of *desi* fowl was taken up at the IVRI and other centres. These schemes proved that it was possible to raise the average egg production from 50 to 150 per hen. Similarly, investigations were taken up on the adaptability of imported breeds like 'Rhode Island Red' and 'White Leghorn'. Investigations were also taken up on cross-breeding as a means of improving production. In 1956 the Council sanctioned a scheme to popularize the raising of day-old chicks to encourage the distribution of improved breeds on a large scale, as by then it was realized that *desi* birds could be replaced by exotic birds. This was followed up by a programme of intensive system of raising flocks on deep litter at Hyderabad and Nagpur in 1957. The units set up at these places demonstrated the possibility of raising poultry on commercial lines by following this system.

In recent years commercial units have come up in collaboration with foreign concerns distributing hybrid chicks. To keep pace with these developments, the Council took up a programme for producing commercial chicks for egg-laying as well as for poultry-meat production through an all-India research project on poultry for eggs and meat.

Encouraging results under this project have been achieved and purelines of birds with high production trait and early maturity have been developed. Their combining ability for producing hybrids is under study for evolving a hybrid chick. Under the studies for broiler production, at different centres purelines have been evolved which are capable of attaining a body weight of 1 200 g in 8 weeks with a feed efficiency of 3.0%. These lines are being further studied for their production potential under different agro-climatic conditions before they are released for commercial use.

## NUTRITION AND PHYSIOLOGY

The low productivity of Indian livestock has been mainly due to non-availability of adequate feed and fodder. The Council took up intensive investigations on different aspects of animal nutrition to meet the shortage of feed by utilizing the existing resources better and by finding new sources of feeds. Research schemes were sanctioned as early as 1937 to find out the feeding value of oilcakes, seeds and grains. The Council

also sanctioned schemes for determining the feeding values of indigenous fodders in the States of Bihar, Assam and the Punjab. Techniques for drying fodders and treating straws were developed. At the IVRI investigations were taken up to find out the nutritional requirements of different categories of livestock. A trace-mineral survey was conducted to find out the requirement of minerals for optimum feeding. Based on this survey, a formula for a mineral mixture was developed and it has been accepted for formulating ISI standards.

In 1954 the Council established Regional Animal Nutrition Stations at Bangalore (Karnataka), Anand (Gujarat), Haringhatta (West Bengal) and Palampur (Himachal Pradesh). These stations conducted systematic surveys on the availability of feeds and determined the nutritional status of livestock in these regions. As a result, it has been possible to develop rations for different categories of stock on a regional basis.

To increase the availability of feeds, investigations were taken up on the utilization of agricultural by-products and waste materials as livestock feeds as early as 1939. A number of subsidiary feeds suitable for the feeding of livestock have been studied and their nutritive values determined. On the basis of the research financed by the Council at various centres, a complete range of conventional and unconventional feeds have been analysed and their nutritive values determined. These values are used for compounding rations for livestock .

With the development of agro-based industries, a large number of new by-products have become available in the recent years. An all-India co-ordinated project on the utilization of agricultural by-products and waste materials has been taken up at eight centres since 1967. The work at these centres has shown that new items, like tapioca leaves, *Cassia tora* seeds, tapioca-starch waste and silkworm pupae can be used in the feeding of livestock. Most of these items have found acceptance on a commercial scale.

An important aspect of research pertains to the study on rumen metabolism. This includes study on digestive changes which take place in the rumen of dairy animals. Compared with cows, buffaloes produce more acetic acid in the rumen by digestion of fodders containing cellulose, especially during the first 24 hr after ingestion. This attribute of buffaloes makes them better utilizers of roughages.

Studies on comparative economics of milk production of buffaloes and better breeds of Indian cattle have indicated that while buffaloes consume significantly less fodder per unit body-weight and the digestibility of crude fibre is significantly higher, the efficiency of conver-

sion of feed into milk is, however, practically equal in buffaloes and cows.

At the IVRI incorporation of urea in concentrate mixtures for growing cattle and milking animals has shown that urea can be used as an economic source of nitrogen to meet 50% of the total digestible crude protein requirements without affecting either growth rate of calves or milk yield and butter-fat production in milking animals. In the urea-supplemented rations, starch could be effectively replaced by factory-made cane-molasses without any adverse physiological or metabolic effects.

## LIVESTOCK DISEASES

Livestock diseases received attention from the very inception of the Council. In 1932, a number of disease-investigation units were sanctioned by the Council in the provinces to investigate the incidence of diseases of livestock, and to devise ways and means for their effective treatment and control. These schemes provided useful information on the prevalence of diseases, their etiology, seasonality, geographical distribution, and measures to control them.

Research conducted at the IVRI had resulted in 1924 in the development of an efficacious vaccine against rinderpest. The Council sanctioned a number of units in 1945 for the improvement of the vaccine. The development of the vaccine against rinderpest and its improvement helped in taking up an all-India programme for the eradication of the disease. Similarly, research programmes were taken up at the IVRI and several State units in 1941 for investigating the diseases of poultry, specifically for developing a vaccine for the control of the Ranikhet disease. This research had a direct bearing on commercial poultry production in the country, because without protection against Ranikhet the maintenance of large flocks was not possible. While the work on contagious diseases was being continued, specific schemes of research were also taken up on diseases like mastitis, brucellosis and tuberculosis in certain States under the programmes financed by the ICAR.

To control the foot-and-mouth disease, an important disease of cattle and buffaloes, a tissue-culture vaccine has been developed at the IVRI. This vaccine is very useful in the protection of exotic cross-bred and other valuable cattle in intensive cattle-development areas. Under an all-India co-ordinated research project the epidemiology of the disease and typing of foot-and-mouth disease virus from the outbreaks of the disease is being undertaken. Along with this compre-

hensive information on the types or subtypes, distribution of virus in different parts of the country and the factors involved in epidemiological aspects of the disease are being studied.

Marek's disease, which has been responsible for heavy losses in poultry, is being studied at different centres under a co-ordinated research programme. The research includes study of the epidemiology of the disease and development of a suitable vaccine for protection of animals. The vaccine developed at the IVRI is being tested under field conditions before release for commercial use.

Respiratory diseases, a serious menace to the poultry industry in the country, have been systematically investigated under a co-ordinated research project. The causal agent has been isolated and identified. A PPLO antigen has been developed and is now being made available by the IVRI for use in the States.

The African horse-sickness first made its appearance in this country in 1965. Prompt research helped in developing a vaccine against it by incorporating into it the local strain of the virus. Besides this vaccine, sera against a large number of other important livestock and poultry diseases have been evolved as a result of researches carried out at the Central and State research centres.

## DAIRYING

The problems relating to the collection of milk from the rural areas and its transportation to towns are important. The Council took up programmes of investigation on long-distance transport of milk from villages to towns at the NDRI, Karnal, and at other centres. With the development of the dairy industry, it was essential to lay down standards for the market quality of milk. In 1946 investigations on the composition of milk were taken up at a number of centres. This was followed by a programme of investigation on the bacteriological qualities of milk at different centres in the country to lay down standards for quality control under the Pure Food Act. The standards developed are being used by public-health authorities in checking adulteration. At the NDRI, Karnal, the Hansa Test has been developed to distinguish cow-milk from buffalo-milk and to prevent the sale of adulterated buffalo-milk as cow-milk. Investigations were also taken up from 1948 onwards to develop a standard method for the analysis of milk to conduct rapid surveys.

There was also a need for developing techniques for the manufacture of milk products. A number of programmes were sanctioned

during 1943-1950 for the manufacture of ghee. With the development of modern dairy industry, investigations were also taken up on the manufacture of cheese and other products from buffalo-milk. At the NDRI a purified liquid rennet has been prepared by abomasal fistula of milk-fed calves. In respect of milk-clotting quality it is comparable with the imported rennet. Techniques have been developed for the production of edible casein from surplus skim-milk or sour milk and yeast protein from whey waste in cheese-manufacturing industries. Co-ordinated projects have been taken up on the utilization of surplus and substandard milk, and on specialized dairy farming.

## FISHERIES

Research on inland and marine fisheries and on fisheries technology is being done at the CIFRI, Barrackpore (West Bengal), the CMFRI and the CIFT, both at Cochin (Kerala). The composite culture technique, involving both Indian and exotic species, developed by the CIFRI has established that fish production in small and medium inland water bodies could be enhanced to at least five times the present yield by suitable combination of species and some supplementary inputs. Successful induced breeding of most of these carps has overcome a major constraint in the availability of quality stocking material in these fish-culture operations. A technique for preserving and ampouling pituitary extract needed for this purpose is also an important promoting factor in fish culture and in setting up 'pituitary banks' to serve as ready sources of injection material. Along with this the Institute also developed efficient devices for hatching the spawn, and later for rearing the fry to fingerlings with maximum survival.

The CMFRI, besides maintaining reliable all-India estimates on marine fish landings and investigations on the causes in fluctuations in the major fisheries as well as on the biology of the commercial species, has been laying special emphasis on the development of mariculture techniques. Successful methods were evolved for culturing such organisms as prawns, mussels, eels and seaweeds. Mussels were reared on ropes suspended in water, whereas seaweeds were cultured on frames with a network of rope. Commercial possibilities of these methods are being demonstrated through pilot projects. Perhaps the most spectacular achievement in recent times has been in the development of indigenous technology for producing culture pearls. A training course to train a band of pearl-culture technicians is also being organized so that an industry could be developed in this field.

The CIFT, in the course of solving some of the technological problems faced by the fishing and fish-processing industry, greatly helped in improving and drawing up quality standards of many marine products. They also worked out a series of processing techniques for converting uneconomical varieties of fish and fish wastes into either wholesome, high-protein content foodstuffs or materials helpful for other industries. Methods developed for prevention of belly-bursting and rancidity in sardines were of considerable significance in the storage and transport of this fish. Several original and economic designs of small and medium fishing crafts and gear suitable for Indian conditions and for specific fishing operations developed by this institute are being increasingly adopted by the fishing industry. Similarly, the Institute has also come up with a number of import substitutes which reduce the strain of foreign exchange on the industry.

## APPENDIX 1

# BIRTH OF THE ICAR—IMPORTANT NOTES AND DOCUMENTS

Note of Sir G. S. Bajpai, Secretary, Department of Education, Health and Lands, on establishment of a Central Organisation to promote and Co-ordinate Agricultural Research (Chapter III of the Report of the Royal Commission on Agriculture; Recommendations : 4-18)

CHAPTER III of the Report of the Royal Commission on Agriculture in India deals with the organisation of Agricultural Research. From the standpoint of the Government of India this Chapter is perhaps the most important, since with the exception of central agencies and institutions for research in agriculture which are still Central subjects, agriculture and veterinary activities have been transferred to provinces, so that the promotion of research and the provision of information are now the only ways in which the Central Government can render substantial assistance to agricultural progress in India. The Commission holds that agricultural research is still in its infancy in India; that without research, organisation for demonstration and propaganda cannot achieve full measure of success; that lack of co-ordination in agricultural research has prejudicially affected progress; and that the Government of India should undertake to promote, guide and co-ordinate agricultural research throughout India, and link it with agricultural research in other parts of the British Empire and in foreign countries. The Commission carefully examined the steps taken to assist agriculture by the Central Governments in the United States of America, in Canada and in Australia, wh re the constitution may be said to present certain analogies to India. They appear to have been most impressed by the Central organisation in Australia established for this purpose by the Commonwealth Government and have taken that organisation as the model for their proposal for India.

THE COMMISSION'S RECOMMENDATIONS

2. *Organisation.* The Commission recommend that the Government of India should establish

(1) An Imperial Council of Agricultural Research. This is to con-

sist of 39 members, and to include

(a) whole-time members including the Chairman, appointed by the Government of India. An account of the function, etc., of these members is given in the following sub-paragraph.

(b) 36 other members, viz., the Director of the Research Institute at Pusa; the Director of the Imperial Institute of Veterinary Research, Muktesar; one representative of the minor administration under the Government; one unofficial elected member of Council of State; two unofficial elected members of the Legislative Assembly; one representative each of the European and Indian business communities; three representatives of Indian Universities nominated by the Inter-University Board; one representative of the Indian Central Cotton Committee; one joint representativ e of the Indian Tea Association and the United Planters' Association of Southern India; nine provincial Directors of Agriculture of the major provinces; the provincial Directors of Veterinary Services, and five other members, nominated by the Government of India, on the recommendation of the Council by reason of their scientific knowledge or other special qualifications.

(2) A sort of special committee of the Council, consisting of 3 whole-time officers, of whom one who will also be Chairman of the Council, is to be an experienced administrator with knowledge, if possible, of Indian conditions; and the other two are to be eminent scientists who have specialised respectively in some branch of crop production and in animal husbandry, including animal nutrition, and veterinary matters.

(3) a Standing Finance Committee to be elected by the Council from its own ranks. It must include the Chairman of the Council and the two whole-time experts referred to in (2).

In addition, the Council may appoint subcommittees for dealing with special branches of its activities; and it is suggested that committees may be set up by local governments in provinces, which would work in close co-operation with the Council, and will further help to maintain touch between that body and agricultural activity in the provinces. Provincial Governments are to have full discretion regarding the constitution of these committees, but the inclusion in them of the Provincial Director of Agriculture and the provincial Veterinary Adviser as a permanent feature is suggested.

3. *Functions*. The duties of the Council will be :

(a) to promote, guide and co-ordinate (i) agricultural and (ii) veterinary research throughout India. The Council will not, however, maintain research institutions directly under its control or have its own staff of experts. It will merely determine whether a particular scheme of research is of all-India or of local importance, whether it can best be carried out at an Imperial or Provincial Research Institution or by some other agency, such as a university or a private individual, and then make the necessary grant;

(b) to train research workers by offering scholarships;

(c) to serve as a clearing house of information in regard to research and to agricultural and veterinary matters generally; and

(d) to take over the publication of scientific papers etc. at present carried out by the Agricultural Adviser to the Government of India.

The whole Council will meet normally twice a year and will exercise such powers as may be entrusted to it. The rules framed in this behalf under the Indian Cotton Cess Act, 1923, are suggested as a model. If this model be followed, the Council will be its own supreme and final executive subject to such control as may be vested in the Governor-General in Council. For the conduct of business, between meetings, the constitution of a Satnding Finance Committee, the constitution of a Standing Finance Committee—vide (3) of Paragraph (2) is recommended. This Committee would also exercise all the powers of the Council in regard to the control and disposal of its funds and such other powers as may be delegated to it by the Council.

The Chairman of the Council and the two whole-time expert members, who have been described as a sort of special committee, will constitute a permanent agency at the headquarters of the Government of India for promoting the objects and carrying out the decisions of the Council. It is contemplated, in accordance, presumably, with the Australian model, that they should tour the provinces in order to maintain constant touch with the provincial authorities and their activities, ascertain their requirements, and help them with advice.

4. *Finance*. The Commission consider that the Council should be placed in a secure financial position, and propose that an Agricultural Research Fund should be constituted for the purpose by a grant of Rs. 50 lakhs from Central Revenues to which additions should be made from time to time as financial conditions permit. This is to be additional to

the cost of (i) the maintenance, and (ii) of the normal expansion of existing institutions, and of any other, which it may be decided to establish. The Commission are of opinion that, if the Council is entrusted with the administration of funds, with which it can supplement research activities on agriculture, the interest of provincial governments in it will become real and lively. It is recommended that the position of the Council in relation to the administration of the Agricultural Research Fund should be analogous to that of the Indian Central Cotton Committee in relation to the funds raised under the Indian Cotton Cess Act of 1923. This committee, *inter alia,* makes grants to provincial Agricultural Departments for specific investigations. Subject to such conditions as the Governor General in Council may prescribe by rules, the Council will have power to incur expenditure on such measures as it may be decided to undertake for promoting agricultural or technological research in India. The budget of the Council will be submitted to the Governor General in Council for sanction; provision will be made for the audit and publication of accounts; and a report of the Council work and a copy of the accounts will be placed annually before the Imperial Legislature.

5. *Procedure.* The Commission recommend that the Council of Agricultural Research and the Agricultural Research Fund should be constituted by an Act of the Imperial Legislature.

6. The need for setting up an organisation which would co-ordinate agricultural research throughout India and stimulate investigations into problems of common as well as local concern may be accepted. It is difficult to dispute the conclusion of the Commission that the "thread of connection between Pusa and the provinces is becoming more and more attenuated". The question for consideration is whether the scheme drawn up by the Commission is best calculated (a) politically, and (b) administratively to achieve this object.

7. From the political standpoint the proposals of the Commission are open to the following objections :

(1) The Central Legislature is given only 3 out of 39 representatives on the proposed Council of Agricultural Research. In its present temper the Assembly will not agree to so small a share in the representation.

(2) The Assembly will also oppose the proposed constitution on racial grounds. In the near future, these proposals cannot be expected to ensure the presence on the Council of more than 14 Indians. This, too, on the assumption that the 3 members of the Legislature, the re-

presentatives of the Indian Cotton Committee and the Indian Commercial community, the three university representatives, one of the three whole-time experts and all 5 of the nominees of the Government of India who are appointed by reason of their scientific knowledge or other special qualifications are Indians.

(3) The Assembly will object to the lump grant of Rs. 50 lakhs in controlling the expenditure of which it will have practically no share. It may be noted that, while the Commonwealth of Australia Science and Industry Research Act, No. 20 of 1926, requires that no money shall be expended from the sum of £250,000 provided by the Act for the purposes of scientific and industrial investigations, except in accordance with estimates of expenditure which have been passed by both Houses of the Commonwealth Parliament, the Commission contemplates no more than the submission to the Imperial Legislature in India of an annual report of activities and an annual statement of accounts.

(4) In its present temper, it is uncertain whether the Legislative Assembly will agree to any legislative measure which does not conform to the wishes of an uninformed and seldom reasonable unofficial majority. The Commission seem to have been at pains to devise a scheme which will remove both the direction and finance of agricultural research in India from the arena of party politics. In suggesting that such unanimity should be secured by means of an Act of the Legislature, they seem to have ignored the intense political bias of at least one house of the Central Legislature in India.

8. From the administrative standpoint, the main objection to the scheme of the Commission is that it will practically leave the control of policy and expenditure to an unwieldy body of 39 experts. It is unlikely that the Council will agree to divest itself of these powers and entrust them to the Standing Finance Committee. The Committee will probably be empowered to deal only with proposals for expenditure, which have to be disposed of between the regular meetings of the Research Council. It is true that the Indian Central Cotton Committee has large powers in regard to both policy and control. But the bulk of the members of the Committee are men engaged in business. Thus the two bodies will essentially be different. It is submitted that, while scientific experts may be admirably suited for research work, they have not the experience or outlook to make good controllers of policy or of finance. It may be urged that in practice these functions will be discharged by the whole-time Chairman. The Commission recommend that the Chairman should be

an experienced administrator, and a man of personality, but it is doubtful whether such a chairman can by himself neutralise the idiosyncracies of a multitude of experts.

9. From the political as well as the administrative point of view, therefore, it is submitted that an alternative scheme may have to be adopted. The scheme must satisfy 4 conditions—

1. It must be elastic;
2. It must secure the good will of the provinces;
3. It must work efficiently; and
4. It must have a good chance of being accepted by the Indian Legislature.

To satisfy the first condition completely, it would be preferable if the scheme were based on executive orders rather than on statute. As has already been stated, no one can prophesy with certainty that a legislative scheme will not be so altered by the Assembly as to seriously detract from its efficiency. Moreover, a scheme of this character will probably require modification from time to time in the light of experience. Such modification will be a far more cumbrous and risky process if adjustments can be effected only by fresh legislation. It must be recognised, however, that as the Commission have recommended legislation, political opinion in India may prefer action on the recommendations relating to the establishment of a Research Council to be taken by legislation, as this would give the Assembly an opportunity to influence the scheme.

The second desideratum, *viz.*, the willing and active co-operation of the provinces, will be secured so long as provision is made for effective consultation and for financial aid to provincial schemes. The latter will provide the strongest stimulus to provincial interest in the activities of any organisation that may be set up to promote and co-ordinate research. As regards the fourth objective, it is most likely to be achieved—

(*a*) if members of the legislature have a substantial share in shaping policy, and

(*b*) if the normal form of financial control over expenditure affecting so important a subject of administration as Agriculture is secured to them.

The best guarantee of efficiency (desideratum 3) will be a suitable division of responsibility and functions between administrators and scientists. Policy must be left to the former; the actual framing of programmes of research, the conduct of research, and advice in determining the relative importance and urgency of proposals for research

must be left to the experts.

10. It is submitted that the organisation and rules of business of the Indian Research Fund Association provide an excellent model for framing an alternative scheme which will satisfy the various conditions discussed in the preceding paragraph. The Indian Research Fund Association consists of—

(1) A Governing Body which has the entire control and management of the affairs, funds and work of the Association. This consists of—

The Hon'ble Member of the Governor General's Council in the Department of Education, Health and Lands, who is President and the following persons, *viz.*—

The Secretary to the Government of India, Department of Education, Health and Lands;

The Director-General, Indian Medical Service;

The Public Health Commissioner with the Government of India;

The Assistant Director-General, Indian Medical Services;

The Director, Central Research Institute, Kasauli;

The Director, Malarial Survey of India, Kasauli;

Raja Sri Krishan Chandra Gajapathi Narayana Deo, Raja of Parlakimedi, District Ganjam.

Other members may be appointed by the President from among members of the Association, who have shown sufficient interest in the objects for which the Association is established.

(2) A Scientific Advisory Board appointed by the Governing Body. This examines all proposals in connection with the scientific objects of the Association, which may be submitted to the Governing Body, and reports as to their feasibility; and includes heads of all provincial, Medical and Public Health Departments and members of the staffs of central and provincial research laboratories;

(3) The Association which is a larger body consists of permanent and temporary members and meets once a year, primarily to transact the formal business of passing the accounts and the annual report. To attract funds, the rules provide for payment by a private individual, who wishes to be a member, of a donation of Rs. 5,000 and upwards, and by temporary members of

a subscription of Rs. 100 per annum.

The scientific objects of the Association are carried out with the aid of working committees which are appointed by and work under the direction of the Scientific Advisory Board.

For finance, the Association depends primarily on (a) an annual grant made by the Government of India and (b) interest from investments made out of savings accruing in the past under (a). As the Association is not a part of the Government, moneys remaining unspent at the end of a year do not lapse to Government. The grant is voted annually by the Legislative Assembly and, if any addition to the amount voted in an expiring financial year is proposed, the approval of the Standing Finance Committee is obtained. Hitherto, no difficulty has been experienced, either in securing the vote of the Assembly or the approval of the Standing Finance Committee to proposals for additional grants.

11. The following concrete suggestions modifying, where necessary, the scheme of the Indian Research Fund Association to meet the special requirements of agricultural research, are made for consideration:-

I. There shall be an Imperial Council of Association of Agricultural Research and will consist of—

(a) a Governing Body;
(b) a special committee of Board of 3 whole-time officers in the employ of the Government of India;
(c) a Scientific Advisory Council;
(d) Provincial Advisory Committees ; and
(e) Special working committees set up for special work.

(a) will be the principal executive body and will include—

(1) The Hon'ble Member in charge of the Department of Education, Health and Lands
(2) The Secretary to the Government of India in the Department of Education, Health and Lands;
(3) The Chairman of the permanent committee of experts, who will be *ex-officio* Secretary of the Governing Body;
(4) one un-official elected member of the Council of State and two similar members of the Legislative Assembly;
(5) one member each of the Indian and European Commercial communities elected by their respective Chambers or Associations of Commerce; and
(6) two members noted for their practical interest in agriculture

nominated by the Governor General in Council after consulting local Governments.

Any four members will constitute a quorum for exercising the powers of the Governing Body. At least one plenary meeting of the Governing Body will be held each year, at which the programme of research framed by the Scientific Advisory Council for the next financial year will be considered and disposed of. In addition, there will be other meetings, whenever occasion may require, to deal with emergent business.

(b) A small Standing Committee of experts in the employ of the Central Government consisting of an officer with experience of administration, and an expert each in agriculture and veterinary matters respectively. These will tour the provinces, keep in touch with the actual progress of research throughout India, report thereon to the Governing Body, and advise on schemes which may be submitted to the Governing Body for sanction, after the annual programme of research, etc., has been considered and approved of.

(c) The Scientific Advisory Council may be constituted on the lines recommended by the Commission for the Imperial Council of Research, and may, after consulting local Governments, even be enlarged so as to include representatives of all universities and experts working outside Government institutions. This body will meet once a year, say in December, consider proposals submitted by provincial committees and other bodies for the ensuing financial year, arrange them in order of importance and urgency, and submit a consolidated programme with any other recommendations it may wish to make for the orders of the Governing Body.

(d) The provincial committees which, as suggested by the Commission, should be appointed by local Governments will keep themselves informed of the progress of schemes of research in provinces and of provincial requirements, will prepare schemes for the future, and maintain touch with the Governing Body and with other provinces through the standing committee of experts *vide* (*v*). It is not suggested, however, that provincial committees should not communicate with one another direct.

(e) The Special Working Committees will be technical Committees, appointed by the Advisory Board, to deal with technical problems and will have power to co-opt members.

12. As regards finance, it is suggested that a grant of Rs. 5 lakhs may be made annually to the Association. Out of this the Governing

Body will make allocations to the various schemes, submitted to it for approval. Any sums saved at the end of a financial year will be carried forward to meet expenditure in the next year or invested. For schemes involving non-recurring expenditure, or expenditure of a recurring character which cannot be met by the Association from its own resources, including the annual grant, but which, in the opinion of the Governing Body, should be proceeded with, application will be made in the usual way to the Government of India. If the latter decide to assist the Association to carry out any such scheme or schemes, they will take steps in the recognised constitutional way to obtain funds from the Legislative Assembly.

13. It is submitted that the alternative scheme outlined above preserves three special features of the mechanism devised by the Commission, *viz.*, (1) the appointment of 3 whole-time experts by the Government of India, (2) the establishment of a larger expert body which will frame proposals for research in the light of full knowledge of the requirements of the whole of India as well as of the provinces, and (3) the constitution of provincial committees. As the Association will be a body corporate, with all the rights and attributes of a legal corporation, it will be able to acquire property by gift. The Commission attach great importance to stimulating private munificence in aid of agricultural research. There is no reason why the modified scheme here suggested should not stimulate private generosity. The scheme also attempts to secure so far as possible, the three main objectives of the Commission, *viz.*, co-ordination of research; the willing and interested co-operation of the provinces in such co-ordination, and larger expenditure from Central Revenues on agricultural research and instruction. In fact, the annual grant proposed in the alternative scheme is double the interest which would accrue from the endowment of Rs. 50 lakhs proposed by the Commission.

14. The alternative scheme differs from the Commission in three important particulars:- It makes the Research Council proposed by the Commission purely advisory; it substitutes a system of recurring grants for a permanent endowment to be supplemented from time to time; and it seeks to set up the requisite machinery by means of executive action instead of legislation. The reasons for these modifications have already been explained and need not be repeated.

15. The Commission doubtless framed their proposals after careful inquiry and reflection. It may be considered that whatever may be its political defects or administrative imperfections, every endeavour should

be made to secure its acceptance by the Legislature. If this view should prevail, it is suggested that advantages should be taken, during the next session of the Indian Legislature, to consult the more influential party leaders regarding the prospects of the scheme being accepted by the Legislative Assembly. If possible, a tentative project of legislation may be prepared before the meeting, and un-official members of the Assembly consulted informally on that. Final decision in regard to action to be taken on this part of the Commission's recommendations will, in that case, have to be deferred until the result of the proposed consultations is available. It must be recognised that this course in making a start towards obtaining the results which the recommendations made in Chapter III of the Report, dealt with in this note, are intended to achieve.

G. S. BAJPAI, 21-6-28

Note of Dr D. Clouston, Agricultural Adviser to the Government of India on the establishment of a Central organization to promote and co-ordinate Agricultural Research

From the standpoint of the Government of India and of local governments chapter 3 of the Report of the Royal Commission on Agriculture is, in my opinion, the most important chapter in the Report. It deals with the organisation of agricultural and veterinary research and stresses the paramount importance thereof in agricultural development. The Commission hold that agricultural research is still in its infancy in India and that lack of co-odination therein has prejudicially affected progress. Their recommendations with regard to the organisation of agricultural research in India are based on the evidence of the many witnesses who gave evidence before them. On the strength of that evidence, the Commission arrived at the unanimous conclusion that it was the duty of the Government of India to promote, guide and co-ordinate agricultural research throughout India and link it with research in other parts of the British Empire and in foreign countries. They arrived at this conclusion after studying very carefully the disabilities under which research was being carried out in India at present and the ways and means employed in other parts of the empire of overcoming these disabilities. They have carefully devised a scheme which will remove both the direction and finance of agricultural research in India

from the arena of party politics in this they were merely following the example of other parts of the Empire. In my opinion their scheme as outlined in chapter 3 of the report should be strongly supported by the Government of India, because that scheme forms the crux of the whole policy of agricultural development which they have recommended for our consideration. The failure to give effect to the basic principles involved would react most unfavourably on the other subsidiary and ancillary scheme recommended in the Report.

Even if the unofficial majority in the Legislative Assembly is uninformed and seldom reasonable, it does not follow that this particular scheme which is otherwise absolutely sound should, on that account, be radically modified to suit their idiosyncracies. If that is to be our political policy, the uninformed and unreasonable members of our legislatures will be given more consideration than they deserve. Personally, I am inclined to think that the majority of the un-official members of the Assembly and Council of State are not unreasonable though I admit that they may be uninformed as regards the aims and objects of the scheme under consideration. Instead of taking for granted that they are unreasonable, we should treat them as reasonable beings and explain to them the aims and objects of the scheme instead of evolving an entirely new one to suit the fancy of the few who are swayed by "intense political bias". We should above all things avoid giving our legislatures any reasons to think that we ourselves do not believe in the scheme which has been so carefully worked out for us by the Linlithgow Commission. To give publicity to the scheme outlined in the Secretary's note by discussing it at the Agricultural Conference to be held shortly would, in my opinion, be unwise. If the temper of the Assembly is such as is described, the schemes now submitted by Secretary would be accepted very probably; but if it were not it would bring us very far on the road of agricultural development for reasons which I shall explain later. Suspicion is easily aroused but more difficult to allay.

The Commission describe in considerable detail the organisation required to bring about co-ordination in the field of agricultural and veterinary research in India. They recommend that the Government of India should establish an Imperial Council of Agricultural Research. This Council would consist of 39 members and would include 3 whole-time members.

the Director of the Agricultural Research Institute, Pusa,
the Director of the Imperial Institute of Veterinary Research,

Muktesar,

one representative of the minor Administration under the Government of India,

one unofficial elected member of the Council of State, two unofficial elected members of the Legislative Assembly,

one representative each of the European and Indian business communities,

three representatives of Indian universities,

one representative of the Indian Central Cotton Committee,

one joint representative of the Indian Tea Association and

United Planters' Association of Southern India, nine provincial Directors of Agricultural, and nine provincial Directors of Veterinary Services, and five other members nominated by the Government of India on the recommendation of the Research Council by reason of their scientific knowledge or other special qualifications

The Council of Research would thus consist of 36 members, in addition to the Chairman and two other whole-time members. Of the 36 members, 8 would be nominated by the Government of India; 18 would represent the provincial agricultural and veterinary departments; 3 would represent the Indian universities, 2 would represent the Indian Central Cotton Committee and planting communities, respectively and 5 would be nominated by the Council of Research for the approval of the Government of India.

The Council would have a Standing Finance Committee elected from amongst its members, with the Chairman of the Council as its *ex-officio* Chairman.

I need not mention the functions of the Council; they are clearly defined in paragraphs 43-48 of Chapter 3 of the Report.

The Commission propose that an agricultural research fund should be constituted by a grant of Rs. 50 lakhs from central revenues to which additions should be made from time to time as financial conditions permit. The Council and the agricultural research fund would be constituted by an Act of the Imperial Legislature and the position of the Council in relation to the administration of the research fund would be analogous to that of the Indian Central Cotton Committee in relation to the funds raised under the provisions of the Indian Cotton Cess Act of 1923. The powers of the Council would be regulated by rules issued by the Governor General in Council in the Department of

Education, Health and Lands similar to those issued under section 15 of the Indian Cotton Cess Act. These rules would *inter alia* regulate the powers of the Council to enter into contracts, to appoint officers and servants and to grant them leave, pay and allowances. They would further regulate the powers of the Council to incur expenditure and would provide for the submission of its budget to the Governor General in Council for sanction, and for the audit and publication of its accounts. They would also provide that its accounts and annual report containing a summary of the work done and of the research and investigations carried out should be placed before the Imperial Legislatures.

Several of the members of the Commission were, I know, doubtful as to the advisability of having the Imperial Legislatures represented on the Council, because they were anxious to remove the direction and finance of agricultural research in India from the arena of party politics. Their final decision was to have on the Council 3 representatives of our Imperial Legislatures. This compromise, though it ensured unanimity, is nevertheless open to objection.

The Commission base their scheme for organisation of agricultural research on the model of the Australian Council for Scientific and Industrial Research. On that Council there is no representative of the Federal Legislature and a sum of £100,000 placed at the disposal of the Council has been vested in the three members of the Executive Committee. The interest on this money is devoted to the training of research workers and to making grants-in-aid to persons engaged in scientific research. The control of policy and expenditure as far as this money is concerned is entrusted, it would appear, to these three members of the Executive Committee. A report of each year's audit of accounts is laid on the table of both Houses of Parliament, but otherwise the control of policy and expenditure is left to the Executive Committee. In addition to this Trust Fund of £100,000 placed at the disposal of the Executive Committee, a sum of 1/4th of a million pounds has been appropriated from the consolidated revenue fund to form a Trust Account, no part of which can be expended except in accordance with estimates of expenditure which have been passed by both Houses of Parliament.

In England the Development Commission constituted by an Act of Parliament in 1910 corresponds more or less to the Research Council, the establishment of which is recommended by the Royal Commission on Agriculture. The Development Commission in England occupies a position distinct from Government departments in the sense that it

is free to report without reference to a Minister; that its recommendations are not subject to confirmation by Parliament, and that its status and procedure are laid down by statute. Mr. Vaughan Nash, the Vice-Chairman of this Development Commission, in his evidence before the Royal Commission on Agriculture, said that it was felt that if a body could be set up with sufficient elasticity and sufficient discretion to deal with things which the more conventionally-minded departments would not easily adapt themselves under their more stereotyped conditions, a move might be made. In addition to flexibility, it was felt that it would be a great thing to have more continuity in this work; that if you were basing your finance in estimates made from year to year, a new Minister might come in, things might happen, and your structure might suffer. Therefore it was felt that if you had a body at once sufficiently flexible and enabled to put up programmes and carry them through for a period of years, also a body that was not amenable to political or departmental pressure, a fair start might be secured."

On the Development Commission in England, there is no member of Parliament and the recommendations of the Commission with respect to expenditure on research are not subject to confirmation by Parliament. Parliament has, in fact, no hand in the appointment of the Commissioners and no control over the administration of the Development Fund. The total amount paid from the Exchequer into the Development Fund up to the 31st March 1927 has been £4,540,000. Including interest the total amount available for development services has been about £ $5\frac{3}{4}$ million sterlings. Grants from the Fund are made by the Treasury on the advice of the Commissioners who, in effect, control the administration of the Fund, as no grants can be made without their sanction. The Treasury may veto the recommendations of the Commissioners but is not empowered to make advances from the Fund except on their recommendations.

Mr. Vaughan Nash, in his evidence, laid stress on the fact that the Commission had been put by Parliament "outside the departments"; that Parliament itself intended that the Commission should act as a buffer against political pressure and at the same time secure continuity in research. When the Development Bill was first brought in, the House of Commons passed what he called a self-denying ordinance; it distinctly restricted its powers in order to secure freedom from political pressure for the Commission.

On the National Research Council of Canada, the legislature is not represented; the members of the Council are nominated by the

Governor General in Council on the recommendation of the committee of the Privy Council on Scientific and Industrial Research.

In my opinion it would be quite safe to leave the control of policy and expenditure to the Research Council and the Standing Finance Committee as has been done with very great success in the case of the Indian Central Cotton Committee. On that Committee there are 44 members of which 15 only are businessmen. As regards the experience and outlook of the members proposed for the Research Council, I should like to point out that 18 of them will be Directors of Agriculture or Veterinary Advisers who are at present controlling to a great extent the policy and expenditure in their own departments and have thus gained experience in administration which should qualify for membership of the Research Council. The same remark applies to the Director of Pusa and the Director of Muktesar. The representative of minor Administrations is likely to be a trained administrator, and the two representatives of European and Indian business communities and the representative of the Planting community would probably be businessmen or administrators or both. The representative of the Indian Central Cotton Committee, too, may be a businessman and the 5 unofficial members to be nominated by the Government of India on the recommendation of the Council may well be trained administrators or businessmen or both. It follows, therefore, that the only members who are at all likely to lack both business and administrative training are the 3 representatives of the universities and the 3 representatives of the Imperial Legislatures. It is just possible that some of the 6 selected may be businessmen as the selection is to be left to the Government of India, it will be within their powers to see that they are.

One of the advantages claimed by the Commission for this scheme for the organisation of research is that it would prove very elastic. Please see paragraph 56 of their report. Mr. Julius, Chairman of the Australian Commonwealth Council for Scientific and Industrial Research and Mr. Vaughan Nash, Vice-Chairman of the Development Commission, both laid stress on the need for the greatest possible flexibility in a scheme of this kind. The latter pointed out that the Development Commission in England had been kept outside the Ministry of Agriculture, because in the nature of things a Government department is always inclined to take a departmental and particularist view of agricultural requirements. He attributed the success of the Development Commission to their having a very elastic constitution and elastic powers.

A Research Council constituted on the lines recommended by the Royal Commission would, I think, secure the goodwill of the provinces, for many of the officials and non-officials, who gave evidence before the Commission, were in favour of research being co-ordinated by a body on which all the provinces would be represented.

The scheme should work efficiently based as it is on experience gained from the working of similar schemes in other countries.

Whether or not the scheme will be accepted by the Imperial Legislatures will depend to a great extent on the methods of explaining it to them.

The organisation and rules of business of the Indian Research Fund Association were considered by the Royal Commission on Agriculture. Though they give it as their opinion that the constitution and work of this Association appeared to be excellent, they did not accept it as a model and for the following reasons presumably—Medical research in India is concentrated at a very few centres: agricultural research is not. The machinery employed for medical research is almost entirely controlled by the Government of India itself, the provinces are not very closely connected with it. There is thus less need for coordination. No great difficulty is experienced at present in co-ordinating the work of the different research sections and institutions which come under the Imperial Department of Agriculture. It is the lack of co-operation between province and province and between the Central and Provincial Departments of Agriculture which we have to overcome. The problem which faces the Indian Research Fund Association is a much simpler one, for this Association is largely a Government of India body which controls the policy of its own research workers. In the sphere of Agriculture on the other hand the provincial departments have their own staffs working independently of the Government of India.

Colonel Graham, in his evidence before the Royal Commission on Agriculture said that for the co-ordination of medical research, he favoured the constitution of a scientific and thoroughly representative Central Research Council with direct representation on the Assembly. The ultimate control at the moment was, he said, a financial one more often than not exercised without any reference to the merits, demerits or necessities of the schemes under consideration. Though therefore the Indian Research Fund Association deals only with the research work carried out at a very limited number of research institutions by officers employed by the Government of India, and though the co-

ordination of that work should not for that reason be a formidable problem it would appear that in the opinion of the Public Health Commissioner with the Government of India the Indian Research Fund Association is not satisfying all requirements. It lacks elasticity; it has no legal status and no guaranteed income. In the Report of the Committee on the Organisation of Medical Research under the Government of India it is stated that this Association has reached a position in which no fresh enterprises of the kinds now urgently demanded can be undertaken without some new production of skilled workers.

In my opinion the constitution of the Imperial Council or Association of Agricultural Research which is modelled on the Indian Research Fund Association could not adequately perform the functions which the Royal Commission propose to entrust to Imperial Council of Agricultural Research. It is not sufficiently representative and would not therefore command the confidence of the provinces.

As regards the provision made for research in Mr Bajpai's scheme, I should like to say that the annual grant of 5 lakhs proposed is quite inadequate. The Development Commission in England have had 5 ¾ million pounds placed at their disposal and the Commonwealth Council in Australia has been provided with £ 350,000 and been promised half a million more. At least half of the annual grant of 5 lakhs proposed by Mr. Bajpai would be swallowed up in salaries to be paid to the permanent staff of the Association. The office of the Indian Central Cotton Committee which is concerned with one crop only, costs us Rs. 1,48,767 and the Committee is spending about Rs. 4,71,779 a year on research and education.

In my opinion a great effort should be made to get the Imperial Legislatures to accept the scheme of the Royal Commission as it stands, and to provide a non-lapsing fund of say Rs. 10 lakhs this financial year (1928-29) and Rs. 50 lakhs in 1929-30. If this could be arranged the Council could be constituted next cold weather.

The functions of the Council would be strictly limited. The Government of India would continue to control its Imperial Department, and the Provinces would continue to control theirs. The position of the Council in relation to the administration of the research fund would be analogous to that of the Indian Central Cotton Committee in relation to the funds raised under the provisions of the Indian Cotton Cess Act. The Council would concern itself mainly with research and the training of research workers it would be a live all-India body representing the institutions and business communities directly

interested in the promotion of agricultural research. Our agricultural departments would continue to perform their many functions, of which research is only one, and their policy would be laid down by the Hon'ble Member for Education, Health and Lands in the one case, and by the Ministers in the other.

The Commission have recommended the establishment of a Research Council in the belief that in these days of specialisation, our specialists in the fields of research, business and administration should co-operate in devising ways and means of guiding, promoting and co-ordinating agricultural and veterinary research in this country. They realised that the transfer of agriculture to popular control had clogged the wheels of such machinery as previously listed for doing this and that research on which all progress in developing agriculture must needs be based had suffered in consequence. They point out that since the Reforms the provinicial departments have, in this all-important matter of research been left without the stimulus of a central organisation which could guide and co-ordinate their policy. The Central Government have, it is true created one such organisation namely the Indian Central Cotton Committee, of which it has good reason to be proud of that all-India organisation the Commission speak in the very highest terms, but the organisation deals unfortunately with one crop only. They have therefore formulated a scheme for the establishmenr of an Imperial Council of Agricultural Research to deal with agricultural and veterinary research in all its branches. The results obtained by the Indian Cotton Committee have more than justified the action of the Government of India in constituting this body and giving it powers which are ordinarily given only to Government departments. Its success has been largely due to the fact that there has been no attempt to departmentalize it.

The Provinces feel that the Committee is looking after their interests with respect to the Cotton Industry. Every member of the Committee takes a practical interest in the development of that industry : they were selected for that very reason. The policy of the Govenment of India has in this case resulted in great achievements which are benefiting both the cultivators and the Trade. In the light of the beneficent result achieved by the Indian Cotton Committee the Government of India would, I hold, be fully justified in establishing on the same lines the research organisation with wider powers recommended by the Royal Commission.

D. CLOUSTON,—6-7-28

Note of Sir M. Habibullah, Member, Viceroy's Executive Council in charge Education, Health and Lands Department, on the establishment of a Central Council of Agricultural Research in India in the Recommendation of the Royal Commission on Agriculture

*(Confidential. Notes. Agriculture-A., March 1929. Pro. Nos. 1-3&K-W)*

My present note is confined to a consideration of the main recommendations contained in Chapter III of the Report of the Royal Commission on Agriculture in India which concerns the Government of India. It will be noticed that this Chapter contains 31 recommendations altogether; but I shall now deal with recommendations 4 to 18, which are germane to the question which I propose to discuss. The remaining recommendations deal with other matters which will be dealt with separately. In passing, however, I feel constrained to express my disappointment at the omission on the part of the Commission to make any specific reference to, or recommendations regarding, an important industry in India, *viz.*, sugar, which, for some years past, has been engaging the earnest attention not only of the country but of the Government of India as well.

2. In the consideration of these important recommendations of the Commission, I have had the benefit of two memoranda, which were prepared for me by the Secretary and the Agricultural Adviser. Both, of course, stress the need and urgency for the acceptance of the recommendation for the establishment in India of an Imperial Council of Agricultural Research. There is, however, a marked divergence of opinion in the memoranda in regard to (1) the constitution of the Council; (2) the method of financing it; and (3) whether it should be launched into existence by means of executive orders or by legislation.

3. For political and administrative reasons, which are given *in extenso* in his note, Mr. Bajpai is of opinion that the organization and rules of business of the Indian Research Fund Association provide an excellent model for framing a constitution for the proposed Research Council.

4. As regards finance, he thinks that the proposal of the Commission for the constitution of an Agricultural Research Fund by Statute by an immediate grant of 50 lakhs of rupees from Central Revenues to which additions should be made from time to time as financial conditions permit, is not likely to meet with the approval of the Legislature,

who will have to be approached to sanction this grant. He is, I believe, keeping in mind our recent experience in regard to a similar proposal for the creation of an endowment in favour of the Archaeological Research in India. He would, therefore, make an annual grant of 5 lakhs of rupees to the Association with provisos that : (1) any sums saved at the end of a financial year will be carried forward to meet expenditure the next year, or invested, and that (2) for schemes involving non-recurring expenditure or expenditure of a recurring character, which cannot be met by the Association from its own resources, including the annual grant, but which, in the opinion of the Government Body should be proceeded with, application will be made, in the usual way, to the Government of India.

5. As regards the method by which the Council should be brought into being, Mr. Bajpai is uncertain whether the Legislative Assembly will agree to any legislative measure which does not conform to the wishes of an uninformed, and seldom reasonable, unofficial majority, and would, therefore, advocate its creation by an executive order.

6. Dr. Clouston's criticisms on Mr. Bajpai's alternative scheme, briefly referred to in paragraphs 3 to 5 *supra*, may be summarised as follows :

(1) that the Science and Industry Research Board in Australia and the Development Board in England contained no representatives of their respective Parliaments;

(2) that the concession made by the Royal Commission on Agriculture in India to political opinion—the Commission recommended the nomination to the Council for Agricultural Research, proposed by them, of two members of the Legislative Assembly and one member of the Council of State—was objectionable in principle ;

(3) that such a Council should be entirely outside political influence, both in its composition and in respect to its financial resources and powers;

(4) that a great effort should, consequently, be made to induce the Central Legislature to accept the scheme outlined by the Commission in regard both (*a*) to the composition of the Council, and (*b*) to the grant to it of a lump sum of 50 lakhs, to be supplemented from time to time as financial circumstances might permit.

Dr. Clouston was further of opinion that if this effort failed, the alterna-

tive scheme, outlined by Mr. Bajpai, should be placed before the Central Legislature.

7. Before coming to any conclusions, I preferred to discuss the whole question with the authors of the divergent memoranda; and, after a free and full discussion of the *pros* and *cons* of the schemes outlined in the Commission's report and in Mr. Bajpai's memorandum, I must confess that I attach considerable importance to the latter. While I admit that the Australian and other foreign models should be carefully considered by the Government of India, there are obvious risks in trying to follow any one of them slavishly. Indian political conditions are different. Public opinion outside the Legislature is not sufficiently informed to consider the proposals of the Royal Commission on Agriculture on their merits; unofficial opinion inside the Legislature is known to be frankly and resolutely political. Further, the Government of India, unlike the Governments of the Dominions, or His Majesty's Government in England, have no Parliamentary majority; on the contrary, they are faced with an opposition which is permanently in the majority. They are bound, therefore, in attempting to give effect to the Commission's recommendations, to consider political probabilities. Owing to a number of circumstances, the unofficial majority in the Legislative Assembly is in a hostile mood. Indeed, it suspects everything that emanates from Government and tries either to wreck a Government measure or to mutilate it. The Navy Bill and the Reserve Bank Bill may be cited as instances in point. In my opinion, it would be doing the cause of agricultural improvement in India a positive disservice to place before the Assembly proposals which, *prima facie*, there is strong reason to believe, would be either thrown out or modified in a manner unacceptable to Government. Indeed, the criticisms which have already appeared in the public press on this particular recommendation of the Commission give an indication of the atmosphere which we must expect in that House. If, as suggested by Dr. Clouston, alternative proposals were presented to the House after the first effort to obtain legislation in the form we contemplated failed, Government would suffer in prestige, precious months would have been wasted in barren controversy and the outcome of the fresh endeavour in an Assembly, rendered possibly more petulant and more unreasonable by its previous destructive success, would be extremely uncertain. I feel, therefore, constrained to come to the conclusion that I should be most reluctant to attempt to give effect to the Commission's recommendations or any other scheme by legislation, I am not convinced too that even if some other expedients were

adopted to carry out the Commission's recommendations, as they stood, e. g., by means of a Resolution, the effort will prove more successful.

8. As regards the lump grant recommended by the Commission, I have no doubt in my mind that the Assembly will not agree to any such proposal on the ground that it did not give it adequate control over its expenditure. This plea was definitely urged by it in turning down a similar grant moved by Government on behalf of the Archaeological Department about two years ago. I see no reason to believe that its attitude in this respect has changed since. Even from an administrative standpoint, it is at best doubtful whether a lump grant has any decisive merit. If the proposed Research Council wished to make grants from the interest of the fund of 50 lakhs recommended by the Commission, this sum roughly 2½ lakhs a year would not be adequate to meet the various demands that were likely to be made. If on the other hand, the sum of 50 lakhs was not to be treated as funded capital but was to be drawn upon to meet the cost of schemes, a stage would soon be reached when the Council would have to approach the Government, and through Government, the Legislative Assembly, for funds. Thus, ultimate dependence on (a) the financial resources of Government, and (b) the vote of the Legislative Assembly, could not be eliminated by any conceivable scheme. It would be prudent therefore to recognise facts from the outset and proceed accordingly. The exact amount of initial grant is to my mind of secondary importance. What it seems necessary to recognise is the desirability of securing the good will of the Legislature. This, I think could only be secured by (a) accepting the principle of recurring grant; the Legislative Assembly would then be able to control the activities of the Research Council by means of the vote; and (b) by entrusting the control of expenditure and policy generally to a body which would be less unwieldy than the Research Council proposed by the Commission. (The Legislature may be given a fair proportion of representatives thereon). The Indian Research Fund Association, of which we have had long and intimate experience can, therefore, supply us with a model which we will do well to copy. I am, therefore, wholly in favour of the alternative schemes propounded by Mr. Bajpai in his elaborate note.

9. During the discussions which I had with Mr. Bajpai and Dr. Clouston, the latter eventually agreed that the modification of the Commission's plans in accordance with the principles enunciated above would be best if prompt and effective action to advance towards the

Commission's main object, namely, the promotion of agricultural research on the basis of co-ordinated activities, was to be taken. He also accepted the principle of annual recurring grants, but urged that the initial grant should be larger than 5 lakhs; otherwise, he feared that the Provincial Governments and the public generally would not be impressed. As regards the structure, functions, and mutual relationship of the Research Council and its connected bodies, Dr. Clouston accepted the alternative proposals made in Mr. Bajpai's note, subject to the understanding, however, that power would be taken by the Governor General in Council to nominate to the proposed Governing Body of the Research Council one or two more members in addition to the ten suggested by the Secretary in his memorandum already referred to. This increased membership was regarded by him as necessary in order to secure provincial interest in the activities of the Council though Dr. Clouston admitted that the chief stimulus to such interest would be provided by the grants-in-aid made by the Council.

10. For the sake of clarity, I summarize below the conclusions which emerge out of the foregoing observations:

I. That the proposal of the Royal Commission on Agriculture in India to establish a Central Organization for agricultural research which would co-ordinate and promote agricultural research in British India through Central, Provincial, and private agencies be accepted;

II. That this organization should consist of
- (i) a Governing Body;
- (ii) a special Committee of an experienced administrator and two technical experts;
- (iii) a scientific advisory body;
- (iv) provincial committees ;
- (v) ad-hoc technical committees;

and should, with the modifications suggested in regard to provincial representation on (i) indicated in the preceding paragraph, be constituted and related to one another, and entrusted with the functions suggested in Mr. Bajpai's note.

III. That this organization should be given :
- (a) an initial grant of, say, 25 lakhs, and
- (b) an annual recurring grant of not less than 5 lakhs.

IV. That the necessary steps to secure the approval of the Legisla-

ture to this scheme should be taken by informal negotiations, and if necessary, by moving a Resolution in the two Houses of the Central Legislature, and not by legislation.

NOTE. Before any Resolution is moved in the Central Legislature, the Provinces must be consulted. This could be done in the Conference which it is proposed to convene to consider the recommendations of the Commission generally.

11. I should like a copy of this note to be submitted to His Excellency at once. My idea is that if His Excellency agrees generally with the suggestions now made by me, the papers may be circulated to my Hon'ble Colleagues. If there is anything in these notes which H. E. would like to discuss with me, I should be glad to wait on him at his convenience. My hope is that a decision on this important question may be reached before H. E. proceeds on tour.

M. H (ABIBULLAH),—12-7-28

Note of Sir Frank Noyce, Officer on Special Duty, dated 24.1.1929, on Council of Agricultural Research. Action taken to constitute the Council

*(Notes. Agriculture-A., July 1929, Pro. Nos. 21-24)*

I have been endeavouring to work out some programme for the Council of Agricultural Research. I have suggested in another file (Agri. A., July 1929, nos. 5-17) that Provincial Governments should be asked at once for their views regarding their representation on the Governing Body of the Research Council and also in regard to the constitution of the Advisory Board. Beyond this I do not think that any formal action can be taken until provision for the Council has been made in the Budget and passed by the Legislature and until the sanction of the Secretary of State to the whole scheme has been obtained. I presume that the latter will be asked for by telegram as soon as the various points outstanding between this Department and the Finance Department have been settled and His Excellency's approval obtained. As soon as that has been done, the Government of India should, I think, issue a Resolution establishing the Council and fixing its constitution. This was the procedure followed in the case of the Indian Central Cotton Committee, which was constituted under a Resolution, dated April 1st, 1921 (Agri.

A., May 1921, nos. 26-58, File no. 22 of 1920), though the Indian Cotton Cess Act (XIV of 1923), under which the Cotton Committee was incorporated, was not passed until 1923.

2. It has been decided that the Council should be registered under the Registration of Societies Act (XXI of 1860). Under section I of that Act "Any seven or more persons associated for any literary, scientific or charitable purpose, or for any such purpose as is described in section 20 of this Act, may, by subscribing their names to a Memorandum of Association and filing the same with the Registrar of Joint Stock Companies form themselves into a society under this Act." I take it that, in the present instance, the "Society" will consist both of the Governing Body and the Advisory Board. Legislative Department should be consulted in regard to this.

3. Section 2 of the Act lays down that "The Memorandum of Association shall contain the following things (that is to say) : the name of the society; the objects of the society; the names, addresses and occupations of the governors, council,directors, committee or other governing body to whom, by the rules of the society, the management of its affairs is entrusted. A copy of the rules and regulations of the society, certified to be a correct copy by not less than three of the members of the governing body, shall be filed with the Memorandum of Association." The first step, therefore, towards the incorporation of the Council under the Registration of Societies Act is to draw up a Memorandum of Association and also rules and regulations. I propose to prepare a draft for consideration by Hon'ble Member and the Legislative Department as soon as the outstanding questions regarding the control by the Council of its budget and powers of appointment to the posts of Vice-Chairman of the Council, whole-time experts and Secretary, have been settled. Meanwhile, we must, I think, ask Legislative Department to advise whether the Memorandum of Association and the rules and regulations have to be approved by the whole society, *i.e.*, the Governing Body and the Advisory Board, or by the whole governing body or by only part of the latter. The difficulty is that the Governing Body as a whole cannot be brought into existence immediately on the issue of the Government of India's Resolution; it will be remembered that it is to consist of :

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| The Hon'ble Member in charge of the Education, Health and Lands Department | 1 |
| The Principal Administrative Officer | 1 |
| Representatives of the Legislative Assembly and the Council of State | 3 |

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|---|---|
| Representatives of European and Indian Commercial Communities | 2 |
| Representatives of the major Provincial Governments | 9 |
| Representatives of the Advisory Board (probably) | 2 |

I have suggested in another file (Agri. A., July 1929, nos. 5-17) that the provincial Governments should be consulted at once about their representatives on the Governing Body. We should, therefore, know who they are to be when the Government of India's Resolution constituting the Council issues and they will be available at once. The representatives of the Legislative Assembly and the Council of State should also be available at once. I do not know whether it is the intention that the Council of State and the Legislative Assembly should elect their representatives on the Governing Body direct or should elect a panel from which (His Excellency the Viceroy would make nominations. This can be discussed in a separate (file Agri.B. (Print), May 1929, nos. 35—38), but I mention the point here to ensure that it is not overlooked. In either case, it should be possible to secure the representative of the Council of State and Legislative Assembly before the end of the present session. This means that fourteen (including the Hon'ble Member and the Principal Administrative Officer) of the eighteen members of the Governing Body will be available at once. The difficulty is in regard to the other four. The intention is that the representatives of the European and Indian Commercial Communities should be elected by the respective Associated Chambers of Commerce. These hold their meetings in December or January, so that if their representatives are to be elected at the annual meetings it will be nearly a year before they will be available. It may be possible to carry through the business by correspondence. If the Hon'ble Member has no objection, I might discuss the point with Sir George Godfrey and Sir Purshotamdas Thakurdas who were the Presidents of the last meetings of the Associated Chambers (I have been unable to ascertain if they are still Presidents). They are both Members of the Legislative Assembly and should, therefore, shortly be in Delhi. There remain the two members of the Governing Body to be elected by the Advisory Board. These obviously cannot be elected until the Advisory Board meets. The Advisory Board cannot be constituted until the Council itself is constituted. The only thing to be done, therefore, appears to be to proceed without these two members. As I read the Act, there is no legal objection to this being done but Legislative Department may be consulted. The specific point on which we want the advice of that Department is whether the existence of the Council of

Agricultural Research will date from the date of issue of the Government of India's Resolution constituting it or from the date on which the Council is actually registered under the Registration of Societies Act and whether it is necessary that the Memorandum of Association and the rules and regulations of the Council should be approved by the whole of the Governing Body or by such members (not less than three as provided by section 2 of the Act as are available.

4. It seems obviously necessary that the Memorandum of Association of the Council and its rules and regulations should be approved by those who are to be the members of the Governing Body. As I have pointed out above, the drafting of the memorandum and of the rules and regulations cannot be taken in hand until the exact measure of control to be exercised by the Government of India over the budget and finances generally of the Council has been settled. Even then, it will probably take a little time as it will be rather a complicated matter. I doubt if it will be possible to get it done satisfactorily until towards the end of April. We cannot bring Provincial and business representatives and those of the Legislative Assembly and the Council of State up to Simla until after the monsoon breaks. I would, therefore, suggest for Hon'ble Member's consideration that a meeting of those who will constitute the Governing Body of the Research Council should be held at Simla towards the end of June. The Memorandum of Association and the draft rules and regulations would be placed before this meeting and, after approval, would be duly filed with the Registrar of Joint Stock Companies. I presume it would have to be filed with the Registrar of Joint Stock Companies for the Punjab. Legislative Department may be asked to advise in regard to this. It should only take a few days to effect registration and the Council of Research should, therefore, be a legal entity at the beginning of July.

5. A point which would have to be determined by the meeting of the Governing Body to be held in June would be when the first meeting of the Advisory Board should be held. If the suggestions I have put forward in another note (Agri. A., July 1929, nos. 5-17) are accepted, the Advisory Board will be composed as follows

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| The three whole-time members | 3 |
| Director of the Pusa Research Institute | 1 |
| Director of the Institute of Veterinary Research, Muktesar | 1 |
| Representative of minor administrations under the Government of India | 1 |
| Representatives of Indian Universities to be nominated by | |

| | |
|---|---|
| Inter-University Board | 5 |
| Representative of the Indian Central Cotton Committee | 1 |
| Joint Representative of the Indian Tea Association and the United Planters' Association of Southern India | 1 |
| Provincial Directors of Agriculture | 9 |
| Provincial Directors of Veterinary Services | 9 |
| Director of the Indian Institute of Science, Bangalore | 1 |
| Representative of the Forest Research Institute, Dehra Dun | 1 |
| Representative of the Indian Medical Research Fund Association | 1 |

Since I wrote my previous note on the subject it has occurred to me that there should be a representative of the Co-operative Department on the Advisory Board. If this suggestion is approved, the representatives of Universities might be reduced to four. We shall, of course, have to provide in the Rules and Regulations of the Research Council that the number both of the Governing Body and of the Advisory Board may be increased from time to time on the recommendation of the Governing Body subject to the approval of the Government of India. It is very much to be hoped that some of the Indian States will make an early application to be allowed to come into the scheme, in which case room would have to be found for their representatives on the Governing Body and the Advisory Board.

I have in the notes referred to above suggested that local Governments might be asked for their views on the constitution of the Advisory Board. Unless they raise any unexpected difficulties, there is nothing to prevent the Board being constituted simultaneously with the Governing Body. The only members of it about whose appointment there is likely to be any delay are the representatives of the Universities, the representative of the Planting Community and the representative of the Indian Central Cotton Committee. The latter committee meets twice yearly in December and July and will probably not be in a position to elect its representative until the July meeting. The Indian Tea Association and the United Planters' Association for Southern India will probably decide to elect their representative by correspondence between the committees of the two Associations. The Inter-University Board meets annually and its meetings are, I believe, usually held in February. I do not know whether it will be necessary to wait till February 1930

for the Board to elect representatives. Sir Akbar Hydari,[1] who is the President of the Board, is, I believe, coming to Delhi next month and I would suggest that he might then be informally consulted about this. It would be unfortunate if it were found necessary to wait until February 1930 for the representative of the Universities on the Advisory Board. We shall, of course, have to make it clear in the Resolution announcing the constitution of the Research Council that the presence on the Governing Body and the Advisory Board of representatives of the business communities, planting community, universities, etc., is subject to the acceptance by these communities and the universities of the initiation to elect members. It would not do to give the impression that they are being dictated to in any way though there cannot be the smallest doubt that they will welcome the opportunity of being allowed to participate in the activities of the Council of Research.

6. Although the Advisory Board of the Council of Agricultural Research can thus be constituted practically simultaneously with the Governing Body, it does not seem advisable to hold a meeting of the Board in June when I have suggested that a meeting of the Governing Body should be called. For one thing, the Council will not be a legal entity until it has been registered under the Registration of Societies Act and a meeting of the full Council does not, therefore, seem advisable until registration has been effected. The Governing Body will have enough to do in June if it confines itself to the discussion of the memorandum of association and the draft rules and regulations and of the way in which it proposes to use its Advisory Board. It will be for the Governing Body to determine when the first meeting of the full Council should be held but I have no doubt that it will be willing to be guided by Hon'ble Member in this matter. I would suggest that the first meeting of the full Council should be held at Pusa in December or at any other time during the cold weather of next year which would be convenient to Hon'ble Member. The meeting should, I think, be held at Pusa and not at Delhi as there will be several members of the Governing Body including, I fear, the great majority of the Provincial Ministers of Agriculture and a few members of the Advisory Board, *e. g.*, the University representatives who will have no knowledge of the work which is being done at Pusa and it is most desirable that, at the outset of the

[1] Is he still its President? Further I do not think he is coming to Delhi this month as the investiture has been postponed.—M H(ABIBULLAH), 2.2.29.

Council's activities, they should make themselves acquainted with the most important institution with which they will be connected and should make the personal acquaintance of the staff of that Institute.

7. The most important and almost the only work of the Advisory Board at its first meeting will be the constitution of the various sub-committees through which it will mainly function. It will have to decide what sub-committees are required and will then proceed to form them. As I envisage the working of the Agricultural Research Council, there will be two sub-committees which will be fully employed—the committee which will deal with the training of research workers and the sub-committee for publications. The latter will, I imagine, be given a free hand by the Governing Body, the schemes prepared by the former would require to be submitted to the Governing Body for its approval. Other sub-committees, *e.g.*, those for sugar or any other important crop, for animal husbandry and for veterinary matters would only be required to meet when there was a definite application for a grant from the Imperial or a Provincial Department of Agriculture. It will be for the Advisory Board to decide whether recommendations from its sub-committees should go to the Governing Body direct or through the full Board. If an application for a grant is favourably reported on, it will be for the Governing Body to decide how far it can be complied with consistently with the other demand on its funds. The Vice-Chairman of the Governing Body will be the Chairman of all sub-committees and the two whole-time experts will be members of the appropriate sub-committee—not necessarily of all sub-committees as it would not seem necessary to put the expert in animal husbandry and veterinary matters on a sub-committee dealing with questions of crop research. It would be the duty of the Vice-Chairman and his two whole-time colleagues to examine the details of all schemes which would probably involve personal inspection in most cases and to report on them to the sub-committee concerned.

8. The last paragraph has been somewhat of a digression but I thought it might perhaps be of use to Hon'ble Member if I were to put on record my views of the manner in which the Council of Agricultural Research is likely to work. The point which emerges from it is that the first meeting of the full Body if it is held in December must be mainly a formal one devoted to the constitution of the various sub-committees and to enabling the members of the Governing Body, the Advisory Board and the Pusa Staff to get acquainted with each other. It does not seem likely that the Provinces or the Imperial Department will be in a posi-

tion to submit applications for grants in time to enable them to be dealt with at that meeting or that the Council of Research would be in a position to deal with them if they were. The expert in Animal Husbandry and Veterinary matters will for example, if he is recruited from outside India, arrive only a short time before the meeting. There are, however, a number of recommendations scattered up and down the Report of the Royal Commission such, for instance, as that "The Council of Agricultural Research should be in a position to advise as to the manner in which experiments with fertilisers can best be conducted so as to secure uniformity of method and to render results obtained in one province of value to other provinces" on which the opinion of the Advisory Board might be obtained at its first meeting. It is unnecessary to enumerate these questions here. It might be decided at the meeting of the Governing Body in June which of these should be referred to the meeting of the Advisory Board in December.

9. The Royal Commission recommended that the Board of Agriculture should be retained and that it should continue to meet under the chairmanship of the (Vice) Chairman of the Council of Agricultural Research. They suggested that the Council of Research should advise the Government of India as to any changes in the constitution of the Council might seem calculated to promote its usefulness. The last meeting of the Board was held in December 1925. It would, in the normal course, have met in February 1928 but the meeting was not held as it was considered preferable to postpone it until after the Royal Commission had reported. The Royal Commission's recommendation on this point is still awaiting orders. It was referred to Dr. Clouston (*vide* linked[2] file) who expressed himself strongly in favour of the continuance of the Board. I see no reason for holding up the consideration of this recommendation any further and would suggest that the recommendation of the Royal Commission in this respect be accepted forthwith. The arguments in favour of the retention of the Board advanced by the Royal Commission in paragraph 67 of their Report and accepted by Dr. Clouston do not require elaboration. Mr. Kamat's proposed "larger gatherings on the model of the Indian Science Congress to be held periodically in different centres throughout the country" would merely be the Board of Agriculture under another name. Dr. Clouston suggested that its next meeting should be held in the cold weather of 1929-30,[2] by which time the Research Council would be functioning. He also suggested that the

[2] Diary No. 2365 of 1928

Council should be asked to give advice as to what changes in the constitution of the Board were desirable. This is another question which might advantageously be referred to the Advisory Board for discussion in December next, but I should not postpone the next meeting of the Board of Agriculture until it has been considered and reported on. From every point of view it seems desirable that the next meeting of the Board should be held in conjunction with the first meeting of the full Research Council. We want, I think, to start the Research Council with something of a "flourish of trumpets" and the best way to do this is to get as large a gathering of agriculturists and veterinary workers together as the conditions at Pusa permit. A meeting of the Board of Agriculture at Pusa in December would still further enlarge the opportunities of the Governing Body to get in touch with the personnel of the Imperial and Provincial Agricultural Departments. The Report of the Royal Commission will have to be gone through very carefully in order to see what points can usefully be referred to the Board of Agriculture—as distinct from the Advisory Board—at its next meeting. Most members of the Advisory Board, *e. g.*, Directors of Agriculture and of Veterinary Services will, of course, also be members of the Board of Agriculture. I imagine that one of the first suggestions of the Advisory Board will be that all members of it should be *ex-officio* members of the Board of Agriculture, a suggestion which was put forward by Sir Thomas Middleton and Dr. Hyder, but I do not think it necessary for the Government of India to anticipate this and to make any changes in the constitution of the Board of Agriculture at this stage. Members of the Advisory Board who were not members of the Board of Agriculture would attend the December meeting of the latter as visitors. Whether the subsequent meetings of the Board of Agriculture should be held annually and alternately at Pusa and in the Provinces as was, I think, very soundly suggested by Sir Thomas Middleton and Dr. Hyder, whether they should always be held in conjunction with meetings of the full Research Council as also seems advisable and whether, again, meetings of the Advisory Board of the latter should always be held in conjunction with a meeting—though not necessarily with all meetings—of the Governing Body are questions which will have in due course to be considered by the Governing Body but which it is not now necessary to discuss.

10. Whether the Council of Agricultural Research comes into being with the issue of the Government of India's Resolution or with the registration of the Council under the Registration of Societies Act, it seems desirable that the Vice-Chairman of the Governing Body and Secretary

should be appointed concurrently with the issue of the Government of India's Resolution. There will be plenty for them to do in arranging the preliminaries and deciding the agenda of the first meeting of the Governing Body in June, in organising an office, in getting into touch with research institutions and workers outside India and in other ways. If Mr. Burt is the whole-time agricultural expert with the Council, it is not quite so necessary that he should join immediately. His advice in regard to the preliminaries would be very helpful but a good deal could be done by correspondence and he could easily be got up to Simla for a week or so if necessary. This point could be decided later when we find out what provision is made in the budget for the staff of the Council. If the Legislative Department hold that the Council for Research cannot come into being until it is registered under the Registration of Societies Act—an opinion which it seems to me they are hardly likely to hold in view of the fact that the Indian Research Fund has never been so registered—Vice-Chairman and Secretary would have to be placed on special duty until the legal formalities were completed. In that case, the cost of the appointments would presumably still be debited to the grant made to the Council for cost of staff, office establishment, etc.

11. To sum up, I submit that

(1) The Government of India should issue a Resolution constituting the Council of Agricultural Research as soon as budget provision has been made and passed and the Secretary of State's sanction to the scheme obtained.

(2) The Legislative Department should be asked to advise whether the existence of the Council of Agricultural Research will date from the date of issue of the Government of India's Resolution constituting it or from the date on which the Council is actually registered under the Registration of Societies Act and whether it is necessary that the memorandum of association and the rules and regulations of the Council should be approved by the whole of the Governing Body or whether it will be sufficient if it is approved by such members as are available.

(3) A meeting of those who are to constitute the Governing Body should be held at Simla in June to discuss the memorandum of association and the draft rules and regulattions after which registration of the Council should be effected.

(4) A representative of the Co-operative Department might

be added to the Advisory Board and the representative of the Universities reduced from five to four.

(5) Provision should be made in the Rules and Regulations for the enlargement of the Governing Body and the Advisory Board from time to time.

(6) The Advisory Board should be constituted simultaneously with the Governing Body but its first meeting should be held at Pusa during the cold weather of 1929-30 in conjunction with the second meeting of the Governing Body.

(7) The Board of Agriculture should be retained but no alteration should be made in its constitution pending a report from the Council of Research as to any changes which may be considered advisable.

(8) The next meeting of the Board of Agriculture should be held in conjunction with the first meeting of the full Council of Agricultural Research.

(9) The Vice-Chairman of the Governing Body of the Council and its Secretary should be appointed concurrently with the issue of the Government of India's Resolution.

(10) The question whether the Agricultural Expert with the Council should be appointed then or later should be reserved for consideration at a later stage.

F. NOYCE,—24-1-29.

I agree in the main with the recommendations which are summed up in paragraph 11 of the note. What is of urgent importance is the reference to the Legislative Department on item (2) of the Summary and this should be done at once.

M. H(ABIBULLAH),—2.2.29.

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Legislative Department.

The effect of the filing of a memorandum of association by the Council of Agricultural Research under section 1 of Act XXI of 1860 will be to constitute the Council a Society under the Act, *i. e.*, a Society to which the Act applies. The existence of the Council as an association of persons for one of the specified purposes is a necessary precedent to the filing of a memorandum of association and the existence of the Council will date from the time when it in fact comes into being whether in pursuance of a Government Resolution or otherwise.

2. The Society will consist of all the persons who are in fact associated for the purposes in question and who subscribe their names to the memorandum of association. The existence of a Governing Body of a Society, which is necessary by virtue of section 2, clearly postulates a larger membership of the Society than of the Governing Body. If therefore the Council is to embrace the Governing Body and the Advisory Board and no one in addition, members of the Advisory Board should no doubt subscribe their names to the memorandum of association and thus become members of the Society.

3. The rules and regulations of the Society should themselves provide for the authority by which they may subsequently be amended. The initial rules and regulations should be made by a body authorised by the Society as a whole to make them. That body need not be identical with the Governing Body set up by the rules and regulations as the body to whom the management of the affairs of a Society is entrusted. It will in fact be entirely in the discretion of the Society to select any personnel it pleases for the purpose.

4. The memorandum of association should be filed with the Registrar having jurisdiction over the place where the Society is situated. If that place is Simla the Registrar will be the Registrar of Joint Stock Companies of the Punjab.

G. H. SPENCE,—23-2-29.

The Council will date its existence from the date set out in the Resolution of the Government of India, if a date is set out, and otherwise from the date of the Resolution itself. From that date the Council is a society and it becomes a registered society from the date of registration under the Societies Registration Act, 1860. A society, however, cannot be registered without the consent of a majority of the members present at a meeting called for that purpose and that majority must number at least 7 persons if it is to be able to subscribe effectively to the memorandum of association. As a preliminary to the memorandum of association being registered the rules and regulations of the society are to be framed presumably by a committee set up for that purpose at a meeting of the society, and thereafter the rules are to be adopted by the society. This does not mean that every member of the society must approve the rules but only that the rules should be accepted at a meeting of the society held for that purpose in the manner prescribed in the rules. After these rules have been adopted, the next step is to prepare a memorandum of association to which the certified copy of the rules and

regulations is to be attached.

L. GRAHAM, 11-3-29

Department of Education, Health and Lands.

Mr. Upton, the Solicitor to the Government of India, has been good enough to look through this file but it was only today that I had an opportunity of discussing it with him.

2. The Legislative Department advise that the Council of Agricultural Research will become a society from the date on which the Resolution of the Government of India constituting it issues. It cannot, however, be registered without the consent of a majority of the members present at a meeting called for that purpose and that majority must number at least seven persons, if it is to be able to subscribe effectively to the memorandum of association. Mr. Graham adds that, as a preliminary to the memorandum of association being registered, the rules and regulations of the society are to be framed, presumably by a Committee set up for that purpose at a meeting of the society, and thereafter the rules are to be adopted by the society. Mr. Upton advises that it is not necessary that the rules should be framed by a committee of the society, and that the better procedure is that which this Department is adopting, namely, to draft a memorandum of association and rules and regulations which can be placed before the society for approval or alteration, if necessary. As Hon'ble Member is aware, I am now engaged in drafting the memorandum and rules and regulations and hope to be in a position to submit them to Hon'ble Member in the course of the next few days.

3. The Legislative Department hold that the rules must be accepted at a meeting of the society held for the purpose in the manner prescribed in the Rules. This is unfortunate. I had hoped that it would be sufficient if the draft memorandum of association and the rules and regulations were placed before, and approved by a meeting of those who are to constitute the Governing Body, but the Legislative Department are definitely of opinion that they must be placed before a meeting of the full society, that is, of the Governing Body and the Advisory Board. It is a great pity as this means inviting 54 people to come to Simla at the end of June or early May to discuss Rules and Regulations. There seems no way out of the difficulty if we are to fulfil the legal requirements and all that can be done is, when invitations to the meeting are issued, to point out that it is merely a formal meeting to discuss Rules and Regulations and that the presence of not more than seven members of those

who are to constitute the Society is all that is necessary .

4. I had suggested that the Advisory Board should be constituted simultaneously with the Governing Body but that its first meeting should be held at Pusa during the cold weather of 1929-30 in conjunction with the second meeting of the Governing Body. I still think it very desirable that the Council should meet at Pusa next cold weather in conjunction with a meeting of the Board of Agriculture, but in view of the opinion of the Legislative Department, this will now be the second meeting of the whole Society and the first after it becomes a Registered Society.

F. NOYCE, 15-1-29

The opinion expressed by the Legislative Department seems to be somewhat in variance with the tentative plans we had chalked out. Insted of calling a meeting of the Governing Body only in the first instance to adopt the draft rules and regulations as a preliminary to registration, we have to summon a meeting of the Society as a whole comprising both the wings—the Governing Body and the Advisory Council. For this purpose we need not wait until the complete personnel of both the wings has been fully constituted according to the constitutions we have finally accepted. At the first meeting the only business to be transacted will be the adoption of draft rules and regulations and also perhaps a resolution to get the Society registered. At the same time we can also secure the signature of members present to the memorandum of the association to be presented to the Registrar of Joint Stock Companies with of course certified copies of the rules and regulations as passed at that meeting. If I have understood the position right, the above is more or less the procedure to be followed. As regards the date of the proposed meeting of the Society, I should prefer to fix it after (1) our own Resolution constituting the Research Advisory Council and Governing Body has issued and (2) the rules and regulations have been framed and duly vetted by Legislative and perhaps also by Finance Department.

M. H. (ABIBULLAH), 18-4-29

I noted on 24th January 1929 that we should have to make it clear in the Resolution announcing the constitution of the Research Council that the presence on the Governing Body and the Advisory Board of representatives of the business communities, planting community, universities, etc. was subject to the acceptance by those communities and the universities of the invitation to elect members. When I noted to this

effect, I was under the impression that we should have made more progress by this time in regard to the establishment of the Council. We have, however as Hon'ble Member is aware, been hung up by the delay in deciding what control the Council should exercise over its budget. The Legislative Assembly and the Council of State are taking steps[3] to elect[4] their representatives on the Council of Research and there seems no reason why the other bodies should not take similar action at once. If Hon'ble Member agrees, the telegram below may issue.

2. We may telegraph to the Secretaries of the Associated Chambers of Commerce of India and Ceylon and the Federation of Indian Chambers of Commerce as follows:

> "Resolution constituting Council of Agricultural Research on lines announced in His Excellency the Viceroy's speech to legislative Assembly on January 28th, 1929, will issue shortly. Government of India have accepted[5] recommendation of Royal Commission on Agriculture that Governing Body of Council should include representatives of European and Indian business communities and consider that these representatives should be nominated by Associated Chambers of Commerce of India and Ceylon and the Federation of Indian Chambers of Commerce, respectively. Please state by wire whether your Chamber would be willing to nominate representative to Governing Body of Council. If so, kindly intimate, as soon as possible, name of representative nominated "

I discussed the subject recently with Sir George Godfrey and Sir Purshotamdas Thakurdas, who were the presidents of the last meetings of the Associated and Indian Chambers respectively, and they were both of opinion that the Chambers would gladly accept the invitation to nominate representatives to the Governing Body of the Council and that there would be no necessity to await the next meetings of the Chambers to get the nomination made, as the business could be carried through quite well by correspondence.

3 As regards the Advisory Board the Inter-University Board has already sent us a Resolution (Agri. A. July 1929. nos. 5-17) passed at its meeting at Patna in February welcoming the proposal made by

[3] Agri B., May 1929, nos. 35-38

[4] Elections have already been held. M. H (ABIBULLAH), 9-4-29

[5] The Royal Commission did not make this recommendation. It is our modification of the Commission's recommendations.

M. H (ABIBULLAH), 9-4-29

the Royal Commission that it should nominate three members of the Council of Agricultural Research. It has been decided that the number of University representatives should be increased to four. The telegram to the Secretary of the Inter-University Board may, therefore run as follows:

"Reference your letter 3808, dated March 27th, 1929. Resolution constituting Council of Agricultural Research on lines announced in His Excellency the Viceroy's speech to Legislative Assembly on January 28, 1929, will issue shortly. Government of India have, accepted recommendation of Royal Commission on Agriculture that Council should include representatives of Indian Universities nominated by Inter-University Board and have decided that number of such representatives should be increased to four. Under modified constitution of Council as announced by Viceroy, these representatives would be members of Advisory Board. Government of India would be glad if early steps could be taken in regard to nomination and if names of representatives nominated could be intimated to them."

4. The telegram to the Secretaries of the Indian Tea Association and the United Planters' Association of Southern India would run as follows :

"Resoultion constituting Council of Agricultural Research on lines announced in His Excellency the Viceroy's Speech to Legisative Assembly on January 28, 1929, will issue shortly. Government of India have accepted recommendation of Royal Commission on Agriculture that Council should include a joint representative of Indian Tea Association and United Planters' Association of Southern India. Under modified constitution of Council as announced by Viceroy this representative would be a member of the Advisory Board. Please wire whether your Association is willing to nominate representative in conjunction with United Planters' Association of Southern India/Indian Tea Association. If so, kindly intimate as soon as possible name of representative nominated."

5. A similar telegram, with suitable modifications, may also go to the Secretary, Indian Central Cotton Committee. It is a *quasi*-Government body but it would hardly be courteous to take its willingness to nominate a representative to the Council of Research as a matter of course. This applies also to the Indian Medical Research Fund Association, which may be addressed by letter.

6. It has been decided that the Advisory Board should include a

representative of the Forest Research Institute at Dehra Dun who would presumably be nominated by Government on the advice of the Inspector General of Forests. No invitation to the Forest Research Institute need be sent.

7. It has also been decided that the Director of the Indian Institute of Science at Bangalore should be invited to serve on the Advisory Board. The Telegram to him may run as follows.

> "Resolution constituting Council of Agricultural Research on lines announced in His Excellency the Viceroy's speech to Legislative Assembly on January 28, 1929, will issue shortly. Government of India consider that your presence on Advisory Board of Council would contribute materially to its successful working. Kindly intimate by wire, as soon as possible, if you would be willing to serve on Board."

I am not sure whether the Director will be able to accept this invitation without the permission of the Council of the Institute but, if their permission is necessary, he will doubtless obtain it.

8. It is the intention that service on the Governing Body and the Advisory Board, except for the three whole-time members, should be purely honorary but non-official members of both would, of course, get the usual travelling and halting allowances. This, I think, will be generally understood and it does not seem necessary to refer to the point in the draft telegrams. It would, however, be as well to make it clear in the Resolution establishing the Council. If the point is raised in any of the replies to the telegrams, we can explain the position.

F. NOYCE, 6-4-29.

I agree. Please also see footnotes. In the light of the latter the wording of the telegram will require some verbal alteration.

M. H (ABIBULLAH), 9-4-29.

Department of Education, Health and Lands Constitution of the Council of Agricultural Research

(*Agriculture A., July* 1929, *Pro. nos.* 75-83)

*Pro. no.* 75. TELEGRAM TO HIS MAJESTY'S SECRETARY OF STATE FOR INDIA, LONDON, NO. 635-AGRI., DATED THE 24TH APRIL, 1929.

*Important*. Your telegram[6] of January 24th. Now that provision for Council of Agricultural Research has been passed by Legislature, we propose to issue Resolution constituting the Council but before doing so desire your approval of certain details of scheme.

2. We are consulting local Governments officially regarding proposal that Ministers of Agriculture should represent Provinces on Governing Body. Replies are incomplete but those so far received indicate that proposal will receive general acceptance as also proposal that Principal Administrative Officer should be Vice-Chairman of Governing Body. Total membership of latter will be eighteen. Seventeen mentioned in our telegram[6] 264-S., dated January 19th, 1929, did not include Chairman.

3. We propose to increase representatives of universities on Advisory Board to four and, in order to increase scientific representation on that body propose to add to it Director of Indian Institute of Science, Bangalore, and representatives of Forest Research Institute, Dehra Dun, and of Indian Medical Research Fund Association. Presence of last of these on Board should do much to secure close touch between work on human and animal nutrition. One representative of Cooperative movement will also have seat on Advisory Board of which total number will remain at thirty-nine.

4. We propose that annual recurring grant of Rs. 7.25 lakhs should be divided into two parts. Rs. 5 lakhs will be for grants for research. The Governing Body of Council will have completely free hand in regard to expenditure of this and of lump grant of Rs. 25 lakhs, of which Rs. 15 lakhs are to be paid this year, subject to condition that it incurs no liability in respect of such matters as leave and pension contributions when research for which grant is given is completed. Annual grant for research will be a non-lapsing one. In regard to grant for staff, establishment, etc., we consider that Council should be in same position as Department of Government of India. Our main reason for this is that, in view of special qualifications required by Principal Administrative Officer, the two whole-time experts and Secretary, we consider it essential that their appointment should rest with us and that we should regulate their leave, pay and allowances. This was contemplated by Royal Commission when model of Indian Central Cotton Committee was suggested. We have considered possibility of giving Council free hand in regard to expenditure on staff other than four officers mentioned above but find that this would give rise to various administrative difficulties.

[6] Agri. A., March 1929, nos. 1-3

5. As already intimated to you, we propose that Principal Administrative Officer should have pay and status of Secretary to Government. For whole-time experts, we propose a salary of Rs. 2,500-125-2,750 *plus* overseas pay of £13-6-8. Tenure of all three appointments would ordinarily be five years and they would not be pensionable unless held by officers already in Government service when they would carry with them eligibility for additional pension at the higher rate. In other cases, provident fund rules for specialist services would apply. We propose that the Secretary to the Council should be an officer of eight to ten years' standing selected from the Indian Civil Service and should be paid on senior time scale of that service *plus* special pay of Rs. 400 per mensem. He should hold the appointment for three years.

6. We accept recommendation of Royal Commission that, on establishment of Council, post of Agricultural Adviser to the Government of India should be abolished and request your sanction to its abolition. Post must remain in existence for purposes of Section 5 of Indian Cotton Cess Act which we propose to amend during next Session of Legislature. From date of constitution of Council until Cotton Cess Act is amended, we propose to appoint Vice-Chairman of Governing Body of Council Agricultural Adviser for purposes of this Act. We also request your sanction to abolition of appointment of Assistant to the Agricultural Adviser which is at present unfilled.

7. We also accept proposal of Royal Commission that Pusa should have a whole-time Director and agree with their views as to the qualifications required for the post. Sanction for the creation of a separate post already exists but financial considerations have hitherto prevented its being utilised. We consider that pay and status of Director should be same as that of whole-time experts with Council of Research and that he should be recruited on five year agreement on same conditions. We do not consider it necessary to attach free quarters to post of Director. We propose to continue appointment of Joint Director until new Director is in position to suggest permanent arrangements.

8. For appointments of Principal Administrative Officer and whole-time agricultural expert with Council, we shall endeavour to obtain suitable officers in India. We do not consider that officers with qualifications required for posts of whole-time expert in Animal Husbandry and veterinary matters with Council of and of Director of Pusa are available in India. We would, therefore, request you to recruit candidates for these appointments in such manner as you think best. We would suggest that Linlithgow and Middleton should be consulted as they

know the type of men required. Middleton's advice in regard to Animal Husbandry expert should be specially valuable.

9. Council will be registered under Registration of Societies Act of 1860. If you approve these proposals, we should be grateful for early reply as we are anxious to issue Resolution constituting Council as soon as possible and to hold meeting of those who will constitute Governing Body in June for consideration of draft Memorandum of Association and Rules and Regulations of Council.

ENDORSEMENT NO. 636-AGRI.

Copy forwarded to the Finance Department with reference to their unofficial Issue no. 1482-Ex. I., dated the 22nd April 1929.

*Pro. no.* 76. TELEGRAM FROM THE SECRETARY OF STATE FOR INDIA, NO. 1501, DATED THE 9TH MAY 1929.

Your telegram, dated April 24th. Council of Agricultural Research. Paragraph 5 . I doubt advisability of formally confining post of Secretary to Indian Civil Service to exclusion of Indian Agricultural and Veterinary Services and new Superior Provincial Services.

2. Paragraph 7. While the pay you propose for Director of Pusa appears suitable, I would prefer to hold myself free to offer a higher rate, if necessary, in order to secure a really first rate man. Otherwise I approve your proposals and will take steps to recruit Director of Pusa and Expert in Veterinary, etc., matters.

Resolution of the Government of India, Department of Education, Health and Lands, Simla, the 23RD May 1929 (No. 826-Agri)

In Chapter III of their Report, the Royal Commission on Agriculture in India held that agricultural research in this country is still in its infancy; that, however efficient the organisation which is built up for demonstration and propaganda, it cannot achieve a full measure of success unless it is based on research; that lack of co-ordination in agricultural research has prejudicially affected progress; that there is a wide field open for the co-operation of the Government of India and of provincial Governments in regard to agricultural research; and that it is the duty of the Government of India, in the discharge of their ultimate responsibility for the welfare of the vast agricultural population of this country, to advance research in every way possible without encroaching upon the

functions of provincial Governments in that sphere.

2. The Royal Commission, after discussing possible methods by which closer contact might be established between scientific investigators working in institutions under the Central Government and investigators employed under provincial Governments, recommended the establishment of an Imperial Council of Agricultural Research to which the Imperial Agricultural Research Institutions and the Provincial Research Institutions would stand in exactly the same relation. The duties of the Council would be:

(a) The promotion, guidance and co-ordination of agricultural and veterinary research throughout India. The Council would not, however maintain research institutions directly under its control, nor would it employ its own staff of experts. It would merely determine whether a particular scheme of research was of all-India or of local importance and whether it could best be carried out at an Imperial or provincial research institution or by some other agency such as a University or a private individual and would then, after subjecting the scheme to examination by its expert advisers, make such grant as it considered suitable.

(b) The training of research workers under a scheme of research scholarships or in other ways.

(c) The collection and dissemination of information in regard not only to research but to agricultural and veterinary matters generally.

(d) The publication of scientific papers, etc.

3. The Royal Commission recommended that the Council of Agricultural Research should consist of the following members :—

(a) Three whole-time members appointed by the Government of India, of whom one should be an experienced administrator with a knowledge, if possible, of Indian conditions; one should be an eminent scientist who had specialised in some branch of crop production and one should represent the interests of animal husbandry including animal nutrition and veterinary matters. It was sugested that the administrator should be the Chairman of the Council.

(b) Thirty-six other members, *viz.*, the Director of the Agricultural Research Institute at Pusa; the Director of the Imperial Institute of Veterinary Research at Muktesar; one representative of the minor administrations under the Government of India; one non-official elected member of the Council of State; two non-official elected members of the Legislative Assembly; one representative each of the European and Indian business communities; three representatives of Indian Universities

nominated by the Inter-University Board; one representative of the Indian Central Cotton Committee; one joint representative of the Indian Tea Association and the United Planters' Association of Southern India; the nine Directors of Agriculture and the nine Directors of Veterinary Services in the major provinces and five other non-official members nominated by the Government of India on the recommendation of the Council by reason of their scientific or other special qualifications.

The Royal Commission recommended that the Council should constitute sub-committees to deal with special activities. They further recommended that provincial Governments should establish committees to work in close co-operation with the Council and to assist in maintaining touch between that body and agricultural activities in the provinces. They considered that provincial Governments should have full discretion regarding the constitution of the provincial committees.

4. As regards finance, the Royal Commission held that, only if the Council were placed in a secure financial position beyond the possibility of being affected by financial vicissitudes, would it be able to embark upon a programme of ordered advance. They, therefore, recommended that an agricultural research fund should be constituted by a grant of Rs. 50 lakhs from central revenues to which additions should be made from time to time as financial conditions permitted. They also recommended that the Council of Agricultural Research and the Agricultural Research Fund should be constituted by an Act of the Imperial Legislature.

5. The Government of India have given their most careful consideration to the proposals of the Royal Commission and are of opinion that they are, on the whole, admirably designed to secure the objects for the attainment of which the establishment of the organisation outlined above is recommended. They feel, however, that the composition of the Council and the method of financing it proposed by the Royal Commission might with advantage be modified in certain respects. It appears to them that a Council of thirty-nine members would be too large to be really effective and that it is not desirable that the Legislative Assembly should be deprived of its normal constitutional control over an activity which affects the staple industry of this country as it would be, if the method of financing the Council proposed by the Royal Commission were adopted. To meet these objections, the Government of India have decided to make the changes in the structure of the Council and the method of financing it which are explained in the subsequent paragraphs of this Resolution.

6. The central organisation will be divided into two parts, with executive and advisory functions respectively. The executive part, which will be known as the Governing Body, will have the management of all the affairs and funds of the Council subject to the limitations mentioned in paragraph 7 below. This body will consist of the Honourable Member of the Governor General's Executive Council in charge of the portfolio of Agriculture, who will be *ex-officio* Chairman, the Principal Administrative Officer of the Council who will be appointed by the Government of India and who will be *ex-officio* Vice-Chairman, one representative of the Council of State, two representatives of the Legislative Assembly, one representative of the European business community elected by the Associated Chambers of Commerce of India and Ceylon, one representative of the Indian business community elected by the Federation of Indian Chambers of Commerce and Industry, one representative nominated by the Government of each major province, two representatives elected by the Advisory Board, and such other persons as His Excellency the Governor General in Council may from time to time appoint.

At the Conference convened by the Government of India in October last to consider the Report of the Royal Commission, the Provincial Ministers of Agriculture expressed the view that the provincial representatives on the Governing Body should be the Ministers of Agriculture. This proposal has been referred to Provincial Governments for opinion and has met with general acceptance. The Government of India entirely agree that the presence of the Provincial Ministers of Agriculture on the Governing Body will contribute very materially to the successful working of the Council. They consider it desirable, however, that provision should be made in the Rules and Regulations of the Council permitting a Provincial Government to nominate a representative to attend any meeting of the Governing Body at which the Provincial Minister of Agriculture is unable to be present.

The Honourable Mr. V. Ramadas Pantulu has been elected by the Council of State and Mian Muhammad Shah Nawaz and Chaudhri Mukhtar Singh have been elected by the Legislative Assembly as the representatives of those bodies on the Governing Body of the Council of Agricultural Research. The Associated Chambers of Commerce of India and Ceylon and the Federation of Indian Chambers of Commerce and Industry have elected Sir Joseph Kay and Mr. Walchand Hirachand, C.I.E., respectively, as their representatives on the Governing Body.

The functions of the Advisory Board will be to examine all propo-

sals in connection with the scientific objects of the Council which may be submitted to the Governing Body, to report on their feasibility and to advise on any other questions referred to it by the Governing Body. It will consist of all those whose inclusion in the Council was recommended by the Royal Commission with the exception of the representatives of the Central Legislature and the representatives of the European and Indian commercial communities who will now find a place on the Governing Body. It does not appear necessary that the latter should also be members of the Advisory Board which, under the division of functions explained above, will be a body of experts. In view of their exclusion from the Advisory Board, the Government of India, after consultation with Provincial Governments, consider it desirable that the scientific and university representation on the Board should be increased and that, subject where necessary, to the acceptance of the invitation to elect representatives to the Board, it should be composed as follows:—

(1) The Vice-Chairman of the Council.

(2 and 3) Two whole-time expert advisers appointed by the Government of India.

(4) Director of the Pusa Research Institute.

(5) Director of the Imperial Institute of Veterinary Research, Muktesar.

(6) Director of the Indian Institute of Science, Bangalore.

The Directors of Agriculture in

(7) Madras.

(8) Bombay.

(9) Bengal.

(10) The United Provinces.

(11) The Punjab

(12) Burma.

(13) Orissa and Bihar.

(14) The Central Provinces.

(15) Assam.

Representatives of the Veterinary Department in

(16) Madras.

(17) Bombay.

(18) Bengal.

(19) The United Provinces.

(20) The Punjab.

(21) Burma.

(22) Bihar and Orissa.

(23) The Central Provinces.

(24) Assam.

(25) A representative of minor administrations under the Government of India nominated by the Government of India.

(26) A representative of the Forest Research Institute, Dehra Dun, nominated by the Government of India.

(27) A representative of the Co-operative Movement nominated by the Government of India.

(28) A representative elected by the Indian Research Fund Association.

(29 to 32) Four representatives of Indian Universities elected by the Inter-University Board.

(33) A representative elected jointly by the Indian Tea Association and the United Planters' Association of Southern India.

(34) A representative elected by the Indian Central Cotton Committee.

(35 to 39) Five non-official members nominated by the Government of India on the recommendation of the Council on the ground of scientific knowledge or other special qualifications.

And such other persons as His Excellency the Governor General in Council may from time to time appoint.

Mr. P. H. Carpenter, Chief Scientific Officer, Indian Tea Association's Experimental Station, Tocklai, Assam, has been elected as their representative on the Advisory Board by the Indian Tea Association and the United Planters' Association of Southern India. The Government of India have nominated Mr. G. K. Devadhar, C.I.E., President, Servants of India Society, Poona, as representative of the Co-operative Movement on the Board. The names of the nominees of the Government of India to represent minor administrations and the Forest Research Institute, respectively, will be announced shortly.

The Principal Administrative Officer to the Council will be *ex-officio* Chairman of the Advisory Board.

All the other features of the Royal Commission's proposals for the organisation of the Council, *viz.*, the three whole-time officers of the Council, the sub-committees to deal with special activities and the provincial committees will remain.

As recommended by the Royal Commission, the duration of the appointment of members of the Council, other than the representatives of the Council of State and the Legislative Assembly and of those mem-

bers who are appointed by reason of the office or appointment they hold, will be three years. The tenure of appointment of the Principal Administrative Officer and the two whole-time expert advisers will ordinarily be five years.

7. For the lump grant of Rs. 50 lakhs recommended by the Royal Commission, the Government of India have decided to substitute an initial lump grant supplemented by a fixed minimum grant annually. They have fixed the initial grant at Rs. 25 lakhs, of which Rs. 15 lakhs have been provided in the budget for 1929-30. Commencing from 1930-31, the annual recurring grant will be fixed at Rs. 7.25 lakhs per annum of which Rs. 5 lakhs will be devoted to the furtherance of the scientific objects of the Council, and the remaining Rs. 2.25 lakhs to the cost of its staff and secretariat. A sum of Rs. 1.40 lakhs has been provided in the current year's budget to meet the cost of the staff and secretariat in this financial year. The provision in the current year's budget has been made with the approval of the Legislative Assembly and the grants to be made in subsequent years will also be subject to its approval.

The Council of Agricultural Research will have an entirely free hand in regard to the expenditure of the grants made to it for research purposes subject to the condition that it incurs no liability in respect of such matters as leave or pension contributions after the research for which the grant is given has been completed. In regard to the grant made to it to meet the cost of staff, establishment, etc., the Government of India have decided that, for reasons of administrative convenience, it should be in the same position as Department of the Government of India Secretariat.

8. The broad outlines of the scheme were placed before the Conference of Provincial Ministers and other representatives in October last and met with general acceptance.

9. The Government of India have further decided that the Council should not be constituted under an Act of the Imperial Legislature as recommended by the Royal Commission but should be registered under the Registration of Societies Act, XXI of 1860. In order to comply with the requirements of that Act, a meeting of those who will constitute the Council will be convened at an early date to consider the terms of the Memorandum of Association and the Rules and Regulations which have to be filed with the Registrar of Joint Stock Companies.

10. Proposals have been approved by His Majesty's Secretary of State regarding the appointment of the Principal Administrative Officer,

the two-whole time expert advisers and the Secretary to the Council. The Government of India hope shortly to be in a position to announce the names of the gentlemen appointed to the first three of these posts. The officer selected for the appointment of Secretary to the Council is M. S. A. Hydari, I.C.S. (Madras).

11. The Government of India trust that all Provincial Governments will take early steps to constitute provincial committees, on the lines suggested by the Royal Commission subject to such modifications as may be considered required in the light of local conditions, to work in co-operation with the Council of Research.

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ORDERED that a copy of the Resolution be communicated to all local Governments and Administrations, the Agricultural Adviser to the Government of India and all Departments of the Government of India, including Financial Adviser, Military Finance.

Ordered also that the Resolution be published in the Supplement to the *Gazette of India* for general information.

G. S. BAJPAI,
*Secy. to the Govt. of India*

APPENDIX 2A

# TENURE OF PRESIDENTS, VICE-PRESIDENTS AND SECRETARIES OF THE ICAR

*Presidents*

| | | |
|---|---|---|
| 1 | Muhammed Habibullah | 1929-1933 |
| 2 | Mian Fazl-i-Husain | 1933-1935 |
| 3 | Kanwar Jagdish Prasad | 1935-1940 |
| 4 | Girja Shankar Bajpai | 1940-1941 |
| 5 | Jogendra Singh | 1941-1945 |
| 6 | Rajendra Prasad | 1946-1947 |
| 7 | Jairamdas Daulatram | 1947-1950 |
| 8 | K. M. Munshi | 1950-1952 |
| 9 | Rafi Ahmed Kidwai | 1952-1954 |
| 10 | Ajit Prasad Jain | 1954-1959 |
| 11 | S. K. Patil | 1959-1963 |
| 12 | Swaran Singh | 1963-1964 |
| 13 | C. Subramaniam | 1964-1967 |
| 14 | Jagjivan Ram | 1967-1970 |
| 15 | Fakhruddin Ali Ahmed | 1970-1974 |
| 16 | Jagjivan Ram | 1974-1976 |
| 17 | Prakash Singh Badal | March-June 1977 |
| 18 | Surjit Singh Barnala | 1977-1979 |

*Vice-Presidents*

| | | |
|---|---|---|
| 1 | T. Vijaya Raghavacharya | 1929-1935 |
| 2 | Bryce Chudleigh Burt | 1935-1939 |
| 3 | Pheroze Kharegat | 1939-1944 |
| 4 | H. R. Stewart | 1944-1946 |
| 5 | Datar Singh | 1946-1952 |
| 6 | K. R. Damle | 1952-1955 |
| 7 | M. S. Randhawa | 1955-1960 |
| 8 | Vidya Shankar | 1960-1962 |
| 9 | G. R. Kamat | March-April 1962 |
| 10 | A. D. Pandit | 1962-1965 |
| 11 | B. P. Pal | 1965-1972 |
| 12 | M. S. Swaminathan | 1972-1979 |

## PRESIDENTS

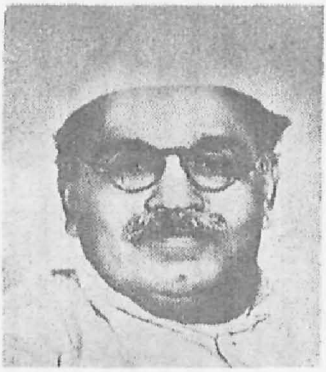
Girija Shanker Bajpai

Jogendra Singh

Rajendra Prasad

Jairamdas Daulatram

K. M. Munshi



Rafi Ahmad Kidwai

A. P. Jain

S. K. Patil

Sardar Swaran Singh

PRESIDENTS

C. Subramaniam

Jagjivan Ram

Fakhruddin Ali Ahmed

P. S. Badal

S. S. Barnala

## VICE-PRESIDENTS

T. Vijayaraghavacharya

Bryce C. Burt

P. M. Kharegat

H. R. Stewart

Datar Singh

K. R. Damle

M. S. Randhawa

V. Shankar

G. R. Kamat

## VICE-PRESIDENTS

A. D. Pandit

B. P. Pal

M. S. Swaminathan

O. P. Gautam

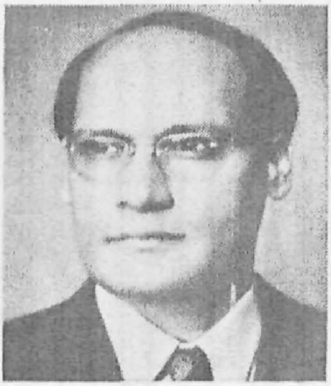
**SECRETARIES**

M. S. A. Hydari

N. C. Mehta

S. Basu

S. M. Srivastava



M. S. Randhawa

T. N. Kaul

Sant Ram Maini

J. V. A. Nehemiah

A. S. Bhatnagar

## SECRETARIES

I. D. Khanna

S. K. Mirchandani

K. P. A. Menon

K. P. Singh

S. S. Dhanoa

## AGRICULTURAL COMMISSIONERS

W. Burns

R. L. Sethi

B. N. Uppal

J. S. Patel

S. M. Sikka

A. B. Joshi

T. R. Mehta

J. S. Kanwar

Sukh Dev Singh

D. R. Bhumbla

N. S. Randhawa

## ANIMAL HUSBANDRY COMMISSIONERS

Arthur Olver

F. Ware

G. Williamson

P. N. Nanda

P. Bhattacharya

L. Sahai

K. K. Iya

B. K. Soni

| | | |
|---|---|---|
| 13 | O. P. Gautam | April 1979-todate |

*Secretaries*

| | | |
|---|---|---|
| 1 | M. S. A. Hydari | 1929-1931 |
| 2 | Malik Charan Das | 1932-1934 |
| 3 | N. C. Mehta | 1935-1938 |
| 4 | S. Basu | 1938-1941 |
| 5 | Bhagwan Sahay | 1941-1943 |
| 6 | S. M. Srivastava | 1944-1945 |
| 7 | M. S. Randhawa | 1945-1946 |
| 8 | T. N. Kaul | 1946-1947 |
| 9 | S. R. Maini | 1947-1951 |
| 10 | J. V. A. Nehemiah | 1951-1958 |
| 11 | S. K. Mirchandani | 1958-1960 |
| 12 | A. S. Bhatnagar | 1960-1964 |
| 13 | I. D. Khanna | 1964-1966 |
| 14 | K. P. A. Menon | 1966-1972 |
| 15 | K. P. Singh | 1972-1977 |
| 16 | S. S. Dhanoa | 1977-todate |

## APPENDIX 2B

# BIODATA OF THE PRESIDENTS, VICE-PRESIDENTS AND SECRETARIES OF THE ICAR

## PRESIDENTS

SIR MUHAMMED HABIBULLAH (1929-1933)[1]

HON. SIR MIAN FAZL-I-HUSAIN

*Born* : 1877. *Education* : M. A. (Cambridge). *Professional Positions* : Professor and Principal, Islamia College (1907-1908); Fellow, Panjab University (1909-1920); President, Punjab Provincial Conference (1914); Member, Legislative Council for Punjab University (1917-1920); Minister of Education (1921, 1924, 1925); President, All-India Mohammeden Educational Conference (1922); Revenue Member, Punjab (1926); Leader of the House (1926-1930); Delegate to League of Nations (1927); Member, Viceroy's Executive Council, Department of Education, Health and Lands (1933-1935). *Major Contributions*: Promoted establishment of Imperial Council of Agricultural Research, added Marketing section to the Council to promote Indian products in foreign markets, responsible for the transfer of the Imperial Institute of Agricultural Research from Pusa to Delhi.

KUNWAR SIR JAGDISH PRASAD, KCSI, Kt, CSI, CIE, OBE, ICS

*Born* : 17 January 1880. *Education* : Allahabad University, Lincoln College, Oxford. *Professional Positions* : Assistant and Joint Magistrate, Magistrate and Collector (1903-21); Provincial Reform Officer (1920); Secretary to the Government of United Provinces (1921-27); Chief Secretary to the Government of United Provinces (1927-1931); Home Minister of United Provinces Government (1933); Member, Viceroy's Executive Council (1935-1940).

SIR GIRJA SHANKAR BAJPAI, KCSI, KBE, CIE, ICS

*Born* : 3 April 1891. *Education* : B. Sc. (Allahabad), B. A. (Allahabad), and Merton College, Oxford. *Professional Positions* : Under-

[1]Information not received

Secretary to the Government of United Provinces (1920-21); Secretary for India at the Imperial Conference (1921) and at the Conference for Limitation of Armaments, Washington (1921-22); on deputation to the Dominion of Canada, Australia and New Zealand (1922); Under-Secretary to the Government of India, Department of Education, Health and Lands (1923); Deputy-Secretary to the Government of India (1926), Secretary to the Government of India (1927-29); deputed to Geneva (1929-1930) and to the Indian Round Table Conference (1930 and 1931); Advisor to Indian Delegation to Imperial Conference (1937); temporary Member of the Viceroy's Executive Council (1935-1936); Secretary to the Government of India, Department of Education, Health and Lands (1932-40); Member, Viceroy's Executive Council (1940-1941).

HON. SIR JOGENDRA SINGH

*Born* : 1877, in Village Rasulpur, District Amritsar, Punjab. *Professional Positions*: Had a farm called Aira Estate in District Kheri, Uttar Pradesh; presided over the Sikh Educational Conference, (1909, 1912, 1927 and 1933); knighted (1929) and awarded KCSI (1946); Home Minister, Patiala State (1910-1913); Minister of Agriculture, Punjab (1926-1937); Member, Viceroy's Executive Council in-charge of the Department of Education, Health and Lands (1941-1945); pioneer in tractor cultivation, used tractors with fuel wood; Editor, 'East and West'. *Publications* : Nur Jahan, Kamla—two novels, and Thus Spoke Guru Nanak, The Sikh Ceremonies, The Persian Mystics, The Invocations of Sheikh Abdullah Ansari of Herat, A. D. 1005-1090, London, 1938. Died : December 1946 at Iqbalnagar (District Montgomery, Punjab).

DR RAJENDRA PRASAD

*Born* : 3 December 1884. *Education* : M.A., M. L., LL.D. (Calcutta). *Professional Positions.* Professor of English, GBB College, Muzaffarpur (1908); practised at Calcutta High Court (1911-16) and at Patna High Court (1916-20); participated in Champaran Agrarian Movement; suspended practice as a lawyer and joined non-cooperation movement (1920); General Secretary, Indian National Congress; Member, Congress Working Committee; President, Indian National Congress (1934, 1939, 1947-48); Member and Minister for Food and Agriculture in Indian Interim Government and first Indian Government after In-

dependence in 1946 and 1947 respectively; Chairman, Indian Constituent Assembly since formation in December 1946; President, Indian Republic (1950-1962); other activities include promotion of Hindi, journalism and social humanitarian and relief work. One of the founders of the Patna English daily 'Searchlight' and the Hindi weekly 'Desh'. *Publications* : India Divided, Atma Katha (autobiography), and Mahatma Gandhi in Champaran. Died : 28 February 1963.

JAIRAMDAS DAULATRAM

*Born* : 1891. *Education* : Graduated in Law. *Professional Positions:* Practised as a lawyer at Karachi (1915-19); joined the Home Rule Movement (1919); took part in Satyagraha movement (1919); Member, All-India Congress Committee since 1917; participated in the non-cooperation movement (1920-21); Editor, 'The Hindu', Karachi (1921); Editor, 'The Hindustan Times', Delhi (1925-26); Member, Bombay Legislative Council (1926-29); joined Satyagraha movement in connection with Salt Act (1930); General Secretary, Indian National Congress (1931-34); Member, Congress Working Committee (1928-41); Governor of Bihar (1947); Minister for Food and Agriculture, Government of India (1947-50); Governor of Assam (1950-1956); Chief Editor of "Collected Works of Mahatma Gandhi" for two years; Member, Rajya Sabha (1959, 1964, 1970).

KANHAIYALAL MANEKLAL MUNSHI

*Born*: 30 December 1887. *Education*: B.A., LL.B., D.Litt., LL.D. (Baroda). *Professional Positions.* Advocate, Bombay High Court (1913); Fellow, University of Bombay and Baroda; MLA, Bombay (1927-46); Member, Working Committee, Indian National Congress (1930), AICC (1930-36 and 1947); Secretary, Congress Parliamentary Board (1934); Home Minister, Government of Bombay (1937-39); Member, Constituent Assembly of India and its Drafting Committee; Member of the Parliament (1947-52); Agent General to the Indian Government, Hyderabad (1948); Chairman, Institute of Agriculture, Anand (since 1951); Trustee, Birla Education Trust and other Trusts (since 1948); Food and Agriculture Minister, Union Government of India (1950-52); Governor of Uttar Pradesh (1953-1958); Founder President, Bharatiya Vidya Bhavan (since 1938); Chairman , Sanskrit Vishwa Parishad (since 1951); Executive Chairman, Indian Law Institute (1957-60); Vice-President,

All-India Swatantra Party. *Publications*: Over 50 books including novels, plays, essays and memoirs in Gujarati, Gujarat and its Legislature; Saga of Indian Sculpture; End of an Era (Hyderabad Memoirs); Warnings of History; Reconstruction of Society through Trusteeship; Foundations of Indian Culture; Krishnavatara Vols I, II, III, IV, V, VI and VII; Indian Constitutional Documents, Vols I and II, etc.

RAFI AHMED KIDWAI

*Born*: 18 February 1894. *Education*: MAO College (Aligarh). *Professional Positions*: Joined the non-cooperation movement in 1921; elected MLA, Centre (1926); Chief of the Congress Party in the Central Legislature (1926-29); joined CD Movement (1930); organized 'No Tax' campaign among the peasants of Rai Bareli; elected General Secretary, United Provinces P C C (1931); started an agitation against the moderate policy of the Congress Working Committee and advocated non-acceptance of office under the 1935 Act; elected President, United Provinces PCC (1935), subsequently elected Member, United Provinces Pegislative Assembly; Revenue Minister, United Provinces L937-39); Home and Revenue Minister, Uttar Pradesh (1946-47); Member, Congress Working Committee (1947-51); Communications Minister, Government of India (1947-51); elected Member of the Parliament (1952), Minister for Food and Agriculture, Government of India (1952-1954). Died: 24 October 1954.

AJIT PRASAD JAIN

*Born*: 1902. *Education*:M.A.,LL.B. (Lucknow). *Professional Positions*: Took part in all Civil Disobedience Movements from 1930 onwards; elected MLA, United Provinces (1937-48); Parliamentary Secretary (1937-39); Member, Constituent Assembly of India (1946-50); Member, Zamindari Abolition Committee, United Provinces; Chairman, U. P. Police Commission and U. P. Agricultural University; Leader of the Plan Projects Agricultural Team in Uttar Pradesh etc.; Minister for Rehabilitation, Government of India (1954-1959); President of the Uttar Pradesh Congress Committee (1961); Governor of Kerala (1965-1966). *Publications*: U. P. Tenancy Act (Commentary on), and miscellaneous contributions to several publications on agrarian questions and land problems.

S. K. PATIL

*Born*: 14 August 1900. *Education*: St Xavier's College, Bombay, London University; studied journalism in London School of Economics and London University. *Professional Positions*: Joined non-cooperation movement in 1920; conducted National School (1920-26); Member, Bombay Corporation (1935-52); General Secretary, Bombay PCC (1929-46); President, BPCC (1946-56); Member, Bombay Assembly (1937-46); Chairman, Government of India, Film Enquiry Committee and Cantonment Committee; Mayor of Bombay for three successive times (1949-52); Member, Constituent Assembly (1947-50); Member, Provisional Parliament (1950-52); President, Indian Motion Picture Producers' Association; Member, Lok Sabha (1952-67, 1969-70); Minister for Irrigation and Power, Government of India (1957); Minister for Transport and Communications, Government of India (1958-59); Minister for Food and Agriculture (1959-63); Minister for Railways, Member, Government of India (1964-67); Treasurer, AICC (1960-64 and 1968-71); Member, AICC (since 1933); Member, Congress Working Committee (1945, 1956-57 and 1960); Member, Central Parliamentary Board (1963). *Recognition*: Royal Geographical Society.

SARDAR SWARAN SINGH

*Born*: 19 August 1907. *Education*: M.Sc.,LL.B.(Lahore). *Professional Positions*: Elected MLA, Punjab (1946); Minister for Development, Food and Civil Supplies, Punjab; Member, Partition Committee, (1947); Minister for Home, General Administrations, Revenue, Irrigation, Electricity, Punjab (1947), Capital Project, Electricity (1952); Minister for Works, Housing and Supply, Government of India (1952-57); led the Indian Delegation to the sessions of the Economic and Social Council of the UN at Geneva (1954, 1955 and 1970); elected to the Lok Sabha; Minister for Steel, Mines and Fuel, Government of India (1957-62); Minister for Railways, Government of India (1962); Minister for Food and Agriculture, Government of India (1963-64); Minister for Industry and Supply, Government of India (1964); Minister for External Affairs, Government of India (1964-66 and 1970-74); Minister for Defence, Government of India (1966-70, 1974-76); Leader, Indian Delegation to UN General Assembly (December 1964, October 1965, September 1966, October 1970, September 1971 and October 1972); assisted Mr Jawaharlal Nehru during talks on Sino-Indian Border Question with Chou En-Lai (1960); took part in the talks preceding signing

of Canal Water Treaty between India and Pakistan (September 1960); led the Indian Delegation to six rounds of talks with Pakistan on Kashmir and related matters (1962-63); led Indian Delegation to the preparatory meeting for the Second Afro-Asian Conference, Jakarta (1964;) assisted Prime Minister Mr Lal Bahadur Shastri in Tashkent Talks with President Ayub Khan of Pakistan (January 1966); re-elected to Lok Sabha (1971).

C. SUBRAMANIAM

*Born*: 30 January 1910. *Education*: B.A. (Coimbatore); B.L. (Madras). *Professional Positions*: Took part in freedom movement (1932, 1941 and 1943); started legal practice at Coimbatore (1936); President, Coimbatore DCC, Member, AICC for a number of years; Member, Constituent Assembly (1946-51); Member of Madras Assembly (1952-62); Finance, Education and Law Minister, Madras Government (till 1962); Member of Lok Sabha (1962-67 and 1971-77); Minister for Steel and Heavy Industry, Government of India (1962-63); Minister for Steel, Mines and Heavy Engineering, Government of India (1963-64); Minister for Food and Agriculture Government of India (1964-67), and also for Community Development and Co-operation (1966-67); Chairman, Committee on Aeronautics Industry (1967-68); Member, Congress Working Committee; President, TNCC (1967-68); Interim President of Congress-R (1969); Chairman, National Commission on Agriculture (1970-71); Minister for Planning, Deputy Chairman, Planning Commission and Minister for Science and Technology, Government of India (1971-74); Minister for Finance, Government of India (1974-77); Member, Governing Council of International Wheat and Maize Improvement Centre, Mexico; Board of Governors of International Rice Research Institute, Los Banos, Manila. *Publications*: Travelogues (in Tamil), Countries I Visited, Around the World, India of My Dreams.

JAGJIVAN RAM

*Born*: 5 April 1908. *Education*: B. Sc. (Banaras and Calcutta Universities); D. Sc. (Ujjain). *Professional Positions*: Appeared before Hammond Commission (1936); started agricultural labour movement in Bihar and formed Bihar Provincial Khet Mazdoor Sabha (1937); took active interest in trade union movement and has been the president of several trade unions; Member, AICC (since 1940); Vice-President, Bihar Branch

of AITUC (1940-46); Secretary, Bihar PCC (1940-46); appeared before the Cabinet Mission as Leader of Scheduled Castes and represented their case (1946); Member of Executive Committee of Hindustan Mazdoor Sewak Sangh (since April 1947); Member, Disciplinary Action Committee of the Congress Working Committee (since its inception), of Congress Working Committee (since 1948), of Central Parliamentary Board of AICC (since 1950), of Central Election Committee (1951, 1956, 1961); President of Requisitionists' Congress (1969-1971); Parliamentary Secretary, Bihar Government (1937-39); Labour Minister, Government of India (1946-52); Minister for Communications, Government of India (1952-56); Minister for Transport and Railways, Government of India (1957-62); Minister for Transport and Communications, Government of India (1962-63), Minister for Labour, Employment and Rehabilitation, Government of India (1966-67); Minister for Food, Agriculture, Community Development and Co-operation, Government of India (1967-70); Defence Minister, Government of India (1970-74); Minister for Agriculture and Irrigation, Government of India (1974-77); formed the Congress for Democracy Party, elected in the General Elections (1977); Minister for Defence, Government of India (1977–1979); led the Indian Delegation to ILO Conference in Geneva (1947); Chairman of Preparatory Asian Regional Conference of ILO, New Delhi (1947); Chairman of 33rd session of ILO (1950); led Indian Delegates to Asian Labour Ministers' Conference (1966) and to FAO Conference, Rome (1967); Member, Indian Institute of Public Administration; Governing Bodies of several Colleges and educational institutions; President of All-India Depressed Classes League (1936-46); Member, Gandhi Smarak Nidhi, Vallabhbhai Patel Memorial Trust; Trustee, Nehru Memorial Trust.

FAKHRUDDIN ALI AHMED

*Born*: 13 May 1905. *Education*: Stephen's College, Delhi; St Catherine's College, Cambridge; Barrister-at-Law, called to the Bar from Inner Temple, London (1928). *Professional Positions*: Advocate, Punjab and Assam High Courts, and Senior Advocate, Supreme Court of India; joined the Indian National Congress (1931); elected to the Assam Assembly (1935); Member, Assam PCC (except for short breaks), its Working Committee and AICC (since 1936); Advocate-General, Assam (1946-52); Member, Rajya Sabha (1954-57); Leader, Indian Lawyers' Delegation to Russia (1955); Member Indian Delegation to UN (1957); MLC, Assam Assembly (1957-66); Minister for Finance, Law, Community

Development, Panchayats and Local Self-Government, Assam Government (1957-62); Minister for Finance, Law, Community Development and Panchayats, Assam Government (1962-66); Minister for Irrigation and Power, Government of India (1966); elected to Rajya Sabha (April 1966); Minister for Education, Government of India (1966-67); Minister for Industrial Development and Company Affairs, Government of India (1967-70); elected to Lok Sabha (1971); Minister for Food, Agriculture, Community Development and Co-operation, Government of India (1970-74); President of India (1974-77). Died: 11 February 1977.

PRAKASH SINGH BADAL

*Born*: 1927. *Education*: B.A. (Lahore). *Professional Positions*: Member of the Shiromani Akali Dal; Member of the Vidhan Sabha, Punjab (1957, 1969); Member of the Parliament (1977), Minister for Agriculture and Irrigation (1977); Member of the Vidhan Sabha, Punjab (1977). *Major Contribution*: Founded the Panchayat Raj Sports Council of Punjab.

SURJIT SINGH BARNALA

*Born*: 21 October 1925. *Education*: LL.B. (Lucknow). *Professional Positions*: Advocate, Nabha; Public Prosecutor, Nabha, Dhanaula and Barnala (1950); Member of the Vidhan Sabha, Punjab (1967-69, 1969-71); Minister for Education, Government of Punjab (1969-71); Member, of the Vidhan Sabha (1972-77); Member of Parliament (1977 to date); Minister for Agriculture and Irrigation, Government of India (1977-1979); President, Indian Council of Agricultural Research (1977-1979).

DR PANJABRAO DESHMUKH

*Born*: 27 December 1898. *Education*: M.A. (Edin.), D. Phil. (Oxon.), Bar-at-Law. *Professional Positions*: Advocate; Minister of Education, PWD and Agriculture, Central Provinces (1930-33); political member and Vice-President, States Council of Dewas (1942-46); Member, Standing Advisory Committees of Agriculture; Indian Central Sugarcane Committee; Chairman, Cotton Marketing Committee; President, All-India Federation of Backward Classes (1950); Founder President, Farmers' Forum, India, Meals for Millions Association; President, All-India Bee Keepers' Association, Ramgarh, U.P., Patron, Rajasthan Poultry Breeders' Association, Jaipur; President, Indian Society of Agronomy, New Delhi; Member,

First Lok Sabha; Minister of Agriculture, Government of India (1952-57); sponsored first Debt Conciliation Act in India and reduced fees of children of farmers in high schools and colleges when Minister of Education, PWD and Agriculture, Central Provinces; represented India as delegate to the FAO Conference at Washington (1948); led Indian delegation to the FAO Conference at Rome (1951); Minister of Co-operation, Government of India.

A. M. THOMAS

*Born*: 4 June 1912. *Education*: B.A.,B.L. *Professional Positions*: Advocate, Supreme Court; Member, Cochin Legislative Assembly (1948), Member, Standing Finance Committee; Member, Committee appointed by Cochin Government to enquire into disabilities of Pali Tenants and Tenancy Select Committee; Member, Travancore-Cochin Assembly (1949-52); Speaker, Travancore-Cochin Legislative Assembly (1951-52); Member, First Lok Sabha (1952-57) and Second Lok Sabha (1957-62); served in a number of important committees constituted by the Parliament and was also the Chairman of the Select Committee on the Rubber Bill; Deputy Minister of Food (1957); Leader of of the (i) Indian Delegation to the United Nations Sugar Conference held at Geneva in 1958 and 1961, (ii) the Food Department, Government of India, delegation to Canada and the USA in 1960.

SHAH NAWAZ KHAN

*Born*: 24 January 1914. *Positions*: Commissioned into the Indian Army (1936); joined the Indian National Army under Netaji Subhash Bose; Member of Parliament (1952-67); Chairman, National Seeds Corporation Ltd (June 1968-January 1971); Concurrently Chairman, FCI (December 1968–January 1971); Minister of State for Steel and Mines, Government of India (Feb to Nov 1973); Minister of State for Petroleum and Chemicals (Nov 1973-Oct 74); Minister of State in the Ministry of Agriculture and Irrigation (10 October 1974–1977).

M. V. KRISHNAPPA

*Born* : 1 July 1918. *Education* : Maharaja's College, Mysore, and Law College, Madras. *Positions* : Member, Board of Directors, Iron and Steel Works, Bhadravati; Member and Chief Whip, Mysore State

Legislative Assembly (1944-52); Member, Mysore Constituent Assembly; Member, First Lok Sabha (1952-57) and Second Lok Sabha (1957-62); Parliamentary Secretary to the Union Minister of Food and Agriculture (12 July-10 August 1952); Deputy Minister, Food and Agriculture (August 1952-March 1962); Chairman, Agriculture Prices Enquiry Committee (1953); Leader, Agricultural Delegations (1954 and 1956); selected by Ford Foundation to study Dairy Development (1961); invited to address the World Rural Youth Conference in Netherlands (1962); elected to Third Lok Sabha (1962) but resigned subsequently to become Minister of Revenue, Food and Animal Husbandry in Mysore State Government.

BHANU PRATAP SINGH

*Born* : 10 August 1917. *Education* : M. Sc. (Maths). *Positions* : President of Farmers' Federation of India (1972); Convenor of the National Co-ordination Committee of Farm Organisations; Member, U. P. Legislative Assembly (1962-67 and 1969-74); elected to Rajya Sabha (1976); Union Minister of State for Agriculture and Irrigation (from 14 August 1977). *Publications*: Author of two books on practical farming, Krishi me Unnati and Gahan Kheti, edited a farmers' journal 'Farmer's Voice'. *Visits Abroad* : Visited UK, France, Switzerland, USA, Mexico, Japan, West Germany, Egypt and other countries.

## VICE-PRESIDENTS

DIWAN BAHADUR SIR T. VIJAYA RAGHAVACHARYA, KBE

*Born* : August 1875. *Education* : Presidency College, Madras. *Professional Positions* : Joined Provincial Service (1898); Revenue Officer, Madras Corporation (1912-17); Secretary, Board of Revenue (1917-18); Director of Land Records (1918); Deputy Director of Industries (1918-19); Dewan of Cochin (1919-32); Collector and District Magistrate (1920); Commissioner for India, British Empire Exhibition (1922-25); Member, Legislative Assembly (1925-26); Director of Industries (1926); Director of Fisheries (1926); Member, Public Service Commission (1926-29); Vice-Chairman, Imperial Council of Agricultural Research (1929-35); Chairman, Madras Government Committee on Co-operation (1939); Prime Minister, Mewar State (since December 1939).

SIR BRYCE CHUDLEIGH BURT, KT, CR, CIE, MBE

*Born* : 29 April 1881. *Education* : B. Sc. (London). *Professional Positions*: Assistant Lecturer, Liverpool University (1902-4); Assistant Government Chemist and Lecturer on Tropical Agriculture, Trinidad; BWI (1904-8); appointed to Indian Agricultural Service (1908); Deputy Director of Agriculture, Kanpur (1908-21); Director of Industries, Uttar Pradesh (in addition) (1912-15); Secretary, Indian Central Cotton Committee (1921-28); Director of Agriculture, Bihar and Orissa (1928-29); Agricultural Expert, (1929-1935), Vice-Chairman, Imperial Council of Agricultural Research (1935-39); Director of Animal Feeding Stuffs, Ministry of Food (1939); Official Adviser to Indian Delegation, Imperial Economic Conference, Ottawa (1932); Foundation Fellow, National Institute of Sciences of India. *Publications* : Many scientific papers in the field of agriculture. Died : 2 January 1943.

SIR PHEROZE MERWAN KHAREGAT, ICS, KT, CIE

*Born* : 1890. *Education* : Bombay and Cambridge. *Professional Positions*: Assistant Magistrate and Collector in United Provinces (1914); Joint Magistrate (1922); Officiating Under-Secretary to the Government of India (1922); Officiating Magistrate and Collector (1923); Officiating Registrar of Co-operative Societies (1926); Secretary, Department of Industries and Education, United Provinces (1932 and 1935); Labour Commissioner (1938); Vice-Chairman, Imperial Council of Agricultural Research (1939-1944); Additional Secretary, Department of Education, Health and Lands, Government of India (1944-45); Secretary, Department of Agriculture (1945).

SIR HERBERT STEWART (RAY), KT, CIE, FRCScI, DIC, NDA

*Born*: 10 July 1890. *Education* : Cambridge, Dublin and London. *Professional Positions* : Military service (1915-19); entered the Indian Agricultural Service as Deputy Director of Agriculture (1920); Professor of Agriculture, Punjab (1921-27); Assistant Director of Agriculture (1928-32); Agricultural Expert, Imperial Council of Agricultural Research, Government of India (1938); Director of Agriculture, Punjab (1932-43); Member of the Legislative Council of the Punjab (1929-43); Agricultural Commissioner with the Government of India (1943-46); Vice-Chairman, Imperial Council of Agricultural Research (1944-46); Agricultural Adviser to British Middle East,

Cairo (1946-51); Principal Consultant, Agricultural, to UN Economic Survey Mission for Middle East (1949); Agricultural Adviser to UN Relief and Works Agency for Palestine Refugees (1950-51); Chief, Agricultural Mission to Columbia of International Bank for Reconstruction and Development (1955-56); Agricultural Consultant to Bank Missions to Pakistan (1958), to Italy (1957), to Yugoslavia and to Uganda (1960) and Kenya (1961-62). *Publications* : Many pamphlets and reports on agriculture and farm accounts in India, and on agriculture in Middle East.

SARDAR BAHADUR SIR DATAR SINGH, FRSA, MDD

*Professional Positions* : Production Commissioner and Additional Secretary, in-charge of GMF; Production Division of the Government of India, Ministry of Food and Agriculture, New Delhi; Cattle Utilization Adviser to the Government of India; Vice-Chairman, Indian Council of Agricultural Research (1946-52); Vice-President, All-India Cattle Show Society; Member, Export Advisory Council, Food Advisory Council and Selection Committee for Armed Forces; Chairman, Cattle Preservation and Development Committee; pioneer in Scientific Breeding and Dairy Farming in India; represented India at the International Dairy Congress, Copenhagen (1931) and Berlin (1937); non-official-Adviser to the Government of India (1937); led Indian Industrial Delegation to Australia and New Zealand (1945); Indian delegate to the International Wheat Conference, London (1947), to Australia for Food Purchase, and to the Food and Agriculture Organisation, South-East Regional Animal Breeding Conference (Conference President); Chairman, International Standardization Organization, Technical Committee, New Delhi (1950); Indian delegate to FAO Conference, Rome (1951), and FAO Co-ordinating Committee and Council Meetings (1952, 1953 and 1954); Leader, Indian Delegation to International Dairy Congress, the Hague (1953).

KASHINATH RAGHUNATH DAMLE, ICS

*Born* : 3 March 1906. *Education* : Allahabad University, King's College, London. *Professional Positions* : Joint Magistrate and District and Sessions Judge in Uttar Pradesh and Ajmer (1930-44); Secretary to the High Commissioner for India in Australia, and Acting High Commissioner (1944-48); Joint Secretary and Officiating Secretary to the

Government of India and Vice-President, Indian Council of Agricultural Research (1952-55); Chairman, Tariff Commission (1955-58); Secretary, Ministry of Petroleum and Chemicals (1963-64); Secretary to the President (October 1964-1965); Lt Governor of Goa, Daman and Diu, and Administrator, Dadra and Nagar Haveli.

DR MOHINDER SINGH RANDHAWA, ICS

*Born* : 2 February 1909. *Education* : B. Sc. (Lahore), M.Sc. (Lahore), D.Sc. (Panjab University). *Professional Positions* : Held government posts in the United Provinces (1934-45); Secretary, Imperial Council of Agricultural Research (1945-46); held senior administrative posts in Delhi and Punjab (1946-55); Vice-President, Indian Council of Agricultural Research (1955-60); Adviser, Natural Resources and Scientific Research, Planning Commission (1961-64); Director-General, Intensive Agricultural Areas and Special Secretary to the Government of India, Ministry of Food and Agriculture (1964-1966); Chief Commissioner, Chandigarh (1966-68); Vice-Chancellor, Punjab Agricultural University, Ludhiana (1968-76). *Positions in Scientific and other Organizations* : President, National Academy of Sciences, Allahabad; President, Association of Vice-Chancellors of Agricultural Universities in India; President, Northern India Science Association, Chandigarh; Chairman, Agriculture and Food Products Division Council, ISI; Member, Board and Governing Body of Council of Scientific and Industrial Research; Member, Executive Council of Birbal Sahni Institute of Palaeobotany, Lucknow; first Indian Member of the International Jury for Kalinga Prize for the Popularization of Science; President, Horticultural Society of India; President, Phycological Society of India, Member, Governing Body of the Indian Council of Agricultural Research; Member, Committee on Merit Promotion and Advance Increments to Scientific Workers constituted by the ICAR; Member, Committee for Selection of Emeritus Scientists of the Indian Council of Agricultural Research; Fellow, Indian National Science Academy, Delhi; Vice-President, Indian Society of Agricultural Statistics; Chairman, Landscape Advisory Committee, Union Territory, Chandigarh; Chief Editor, Monographs on Algae Series, Indian Council of Agricultural Research, New Delhi; Chief Editor, Monographs on Botany Series, Council of Scientific and Industrial Research, New Delhi; Chief Editor, Roopa-Lekha, the journal of the All-India Fine Arts and Crafts Society, New Delhi; *Publications* : Beautifying India, Flowering Trees in India, Agri-

culture and Animal Husbandry in India, Agricultural Research in India: Institutes and Organizations, Beautiful Trees and Gardens, Flowering Trees, Evolution of Life, Zygnemaceae, Developing Village India : Studies in Village Problems, Out of the Ashes : study of the Rehabilitation of refugees in the East Punjab, National Extension Service and Community Projects in Punjab, Farmers of India—Vols 1-4, joint author. *Hindi.* Bharat men Pushp Vriksh, Bharat men Krishi aur Pashupalan, Folk Songs of Kangra, Kulu and Haryana. *Punjabi* : Sunder Rukh de-Bagh Bagiche, Folk Songs of Punjab.

Studies on Natural Resources, Natural Resources of India, Co-ordinated Study of Organizations Concerned with the Survey of Natural Resources, Study on Wastelands including Saline, Alkali and Waterlogged Lands and their Reclamation Measures, Study of Cotton in India, Study of Groundnut in India, Study on Utilization of Urban Wastes; Study on Coconut in India, Survey and Utilization of Agricultural and Industrial By-products and Wastes, Study on Jute and Mesta in India. *Honours* : Presented Robe of Honour by the Punjab Government for Services to Punjabi Literature (1968); presented Fellowship of the Indian Standards Institution (1968); awarded the Grant Gold Medal by the Royal Agri-Horticultural Society of India, Calcutta (1971); awarded Padma Bhushan by the President of India in recognition of services to Indian Administration, Art and Agriculture (1972); awarded a plaque by the Punjab State Co-operative Fruit Development Federation; awarded the Degree of Doctor of Science (*honoris causa*) by the University of Udaipur, Rajasthan, in recognition of his services to art and horticulture (1974) and by the Punjabi University, Patiala (1978). The Ohio State University, Columbus, Ohio, have decided to confer the degree of Doctor of Science (*honoris causa*) on him in recognition of his services in the fields of Administration, Art and Agriculture.

VIDYA SHANKAR, ICS

*Born* : 10 November 1909. *Education* : M. A. (Kanpur), University School of Arts (Allahabad), and St John's College, Oxford. *Professional Positions* : ICS (1933); Assistant Collector (1933-39); Under-Secretary to the Government of Bombay (1939-40); Deputy Secretary (1940-41); Under-Secretary to the Government of India (1941-43); and Deputy Secretary (1943-46); Private Secretary to the Home Member (1946-47); Private Secretary to the Deputy Prime Minister (1947-50); Joint

Secretary (1948-54); Collector of Banaskantha (1954-55); Secretary to the Government of Bombay (1955-60); Special Secretary, Ministry of Food and Agriculture (1960-62); Vice-President, Indian Council of Agricultural Research, New Delhi (1960-62); Secretary, Department of Food, Ministry of Food and Agriculture (1962-64); Secretary Aviation, Ministry of Transport, Aviation, Shipping and Tourism, Government of India; also Chairman, ICAC (1964); Vice-President, Council of International Civil Aviation Organization (1965).

G. R. KAMAT, ICS

*Born* : 26 December 1908. *Professional Positions* : Entered Government Service on 12 October 1931, on deputation to the Government of India; Deputy Chairman, Life Insurance Corporation, Bombay; Vice-President, ICAR (March-April 1962).

A. D. PANDIT, ICS

*Born* : 1 April 1909. *Education* : Allahabad, Oxford. *Professional Positions* : Joint Magistrate and District Magistrate (1933-42); Deputy Secretary to the Government of United Provinces (1942-45); Secretary, Government United Provinces; Chief Secretary, Government of Assam (1950-52); Chief Commissioner, Ajmer State (1952-54); Chief Commissioner, Delhi (1954-59); Fellow, Centre for International Affairs, Harward University (1960-61); in Planning Commission (for a brief period); Speical Secretary to the Government of India, Department of Agriculture, Ministry of Food and Agriculture; and Vice-President, ICAR (1962-65); Secretary, Ministry of Defence, Government of India (1965).

DR B. P. PAL

*Born* : 26 May 1906. *Education* : M. Sc. Hons (Panjab); Ph. D. (Cantab.). *Professional Positions* : Second Economic Botanist, Imperial Economic Botanist (later re-designated Head of the Division of Botany), Director, Indian Agricultural Research Institute, New Delhi; Director-General, Indian Council of Agricultural Research, New Delhi (1965-1972); Leader, Indian Delegation to the International Botanical Congress, Paris (1954); Official Delegate to the International Genetics Symposium, Japan (1956); Member, Indian Delegation to Commonwealth Scientific Committee, New Zealand (1961). *Recognition* : President, Botany and Agricultural Sciences Section of the Indian Science Cong-

ress, Indian Botanical Society, Indian Society of Genetics and Plant Breeding, Horticultural Society of India; President, Rose Society of India and Delhi Agricultural Society; Vice-Chairman, All-India Fine Arts and Crafts Society; and Member of many scientific organizations and committees. *Awards* : FLS, FRHS, FBS, FNI, FRS, Padma Shri (1958); Rafi Ahmed Kidwai Prize for Agricultural Botany (1960); Birbal Sahni Medal for Botany (1962); Srinivasa Ramanujam Medal (1964).

DR MOMKOMBU SAMBASIVAN SWAMINATHAN

*Born* : 7 August 1925. *Education* : B. Sc. (Travancore); B.Sc. Agriculture (Coimbatore); Associateship in Genetics and Plant Breeding, Indian Agricultural Research Institute, New Delhi; Ph. D. (Cambridge); UNESCO Fellow in Genetics (Agricultural University at Wageningen); Research Associate in Genetics (University of Wisconsin, USA); *Honorary Degrees* : D. Sc. from the Sardar Patel University, Vallabha Vidyanagar; Haryana Agricultural University, Hissar; Andhra Pradesh Agricultural University, Hyderabad; Andhra University, Waltair; G. B. Pant University, Pantnagar; Jodhpur University, Jodhpur; Marathwada Krishi Vidyapeeth; Kumaon University. *Professional Positions* : Assistant Botanist at the Central Rice Research Institute, Cuttack (1954); Assistant Cytogeneticist (1954-56), Cytogeneticist (1956-61), Head, Division of Botany (1961-66) and Director (1966-1972) at the Indian Agricultural Research Institute, New Delhi; Director-General, Indian Council of Agricultural Research and Secretary to the Government of India (1972-79). *Positions in International Scientific Committees* : Vice-Chairman, Technical Advisory Committee to the Consultative Group on International Agricultural Research constituted by the Food and Agriculture Organisation of the United Nations; International Bank for Reconstruction and Development and the U.N. Development Programme; Vice-Chairman, Protein Advisory Group to the United Nations System; Member, Board of Trustees, International Maize and Wheat Research Centre, Mexico; Member, Board of Trustees, International Crop Research Institute for the Semi-Arid Tropics; Vice-President, Society for the Advancement of Breeding Researches in Asia and Oceania; Chairman, International Scientific Committee constituted to review the research contributions of the International Rice Research Institute. *Recognitions*: Fellow of the Indian National Science Academy (FNA); Fellow of the Indian Academy of Sciences (FASc); Fellow of the Royal Society of London (FRS); Foreign Associate of the National Academy of Sciences,

USA; Honorary Fellow of the National Academy of Sciences; Honorary Fellow of the Swedish Seed Association, Sweden; Vice-President of the International Congress of Genetics, the Hague (1963); General President, Indian Science Congress, Waltair (1976). *Awards* : Shanti Swarup Bhatnagar Award for contributions to Biological Sciences (1961); Mendel Memorial Award of the Czechoslovak Academy of Sciences for contributions to Plant Genetics (1965); Birbal Sahni Medal of the Indian Botanical Society for contributions to Applied Botany (1966); Silver Jubilee Commemoration Medal of the Indian National Science Academy for contributions to Genetical and Agricultural Research (1973); Barclay Medal of the Asiatic Society for contributions to Genetics. Padma Shri (1967); Padma Bhushan (1972); Ramon Magsaysay Award for Community Leadership. *Publications* : Over 200 research papers. *Major Scientific Contributions* : Developed the concept of National Demonstrations ; demonstrated the concept of Seed Village in the village Jounti in Delhi State. Assisted in the initiation of the High-Yielding Varieties Programme, Dry Land Farming Pilot Projects, Multiple Cropping Pilot Projects and the Intensive Cotton Development Programme, and Lab to Land Programme; Elucidation of the origin and differentiation of potato species; understanding the genetic relationships among wheat species; accomplishment of difficult crosses in potato and jute species; standardization of techniques for the induction of mutations and polyploidy in several economic plants; elucidation of the numerous factors influencing the induction and recovery of mutations in plants; identification of the barriers to high yields in wheat and the initiation of wheat breeding programme, involving the Norin dwarfing genes obtained from Mexico; development of the concepts of crop cafeterias, mid-season corrections in crop scheduling and alternative cropping strategies for different weather conditions; purposeful manipulation of genes in improving theyield, quality and stability of performance of several economic plants; development of whole village for watershed operational research projects based on principles of ecology and economics.

DR O. P. GAUTAM

*Born* : 24 January 1924. *Education* : B. Sc. (Agra); M.Sc. Agric.; (Agra); Ph.D., University of California, Davis, USA. *Professional Positions* : Assistant Professor (1948-51), Professor of Farm Management (1951-55), Professor of Agronomy (1958), B. R. College, Agra; Research

Assistant, Department of Agronomy, University of California, Davis, California, USA (1955-57); Professor of Agronomy (1958-60), Head, Division of Agronomy (1960-63), Deputy Director (Research) and Head, Division of Agronomy (1963-66), Indian Agricultural Research Institute, New Delhi; Deputy Director-General, Indian Council of Agricultural Research, New Delhi (1963-66, 1976-79); Agricultural Educator, South-East Asia Region, World Bank, Washington DC, USA (1973-76); Director-General, Indian Council of Agricultural Research, New Delhi (1979). *Positions in International Scientific Committees* : Consultant to UNESCO to advise on the development of the Faculty of Agriculture of the University of Malaysia, Kuala Lumpur (1971); Project Director of the UNDP/UNESCO/ FAO Project on Postgraduate Agricultural Education and Research in India (1971-73, 1976-78); Fund Administrator of the National Agricultural Research Project funded by the World Bank (1978-todate); Project Director, ICAR—UNICEF Project on Nutrition Education and Research at Agricultural Universities; Member of the Indian Delegation to the Commonwealth Scientific Conference, Ghana (1966); Member of the Indian Delegation to the International Commission on Irrigation and Drainage, New Delhi (1966); Member of the Delegation of Vice-Chancellors to the Convention of US Universities and Land Grant Colleges at Washington DC (1967); Member of the Indian Delegation to the Technical Assistance Conference, Purdue University, USA (1969); Member of the Indian Delegation to the World Education Conference, Copenhagen (1970); Member of the Indian Delegation to the Travelling Seminar of Asian Agricultural Universities, Bangkok (1970); Leader of the Indian Team for Negotiating Educational Project with IBRD, Washington DC (1972); Member of the Indian Delegation to the Regional Conference on Education for Development, New Delhi (1977); Leader of the High Level Team to study Agricultural Education System in Hungary (1977); Leader of the Delegation of Vice-Chancellors to study Agricultural Education System in USSR; Leader of the Indian Team for Negotiating National Agricultural Research Project with IBRD, Washington DC (1978). *Recognitions*: Joint Secretary, Indian Society of Agronomy (1964-65); Vice-President, Indian Society of Agronomy (1966-70); Chief Editor, Indian Journal of Agronomy (1966-70); President, Indian Society of Agronomy (1973-74). *Publications* : Published about 60 scientific papers in the field of agronomy and agricultural education. Co-author of the following reports: Reports of Indo-US Study Team for assignment of USAID Technical Assistance Programme to Agricultural Universities in India

(1967); Assessment of the Punjab Agricultural University progress (1970); Methodology for the assessment of progress of Agricultural Universities in India (1970); Completion Report of the First Education Project in the Philippines (IBRD, 1973); Education Sector Survey in Indonesia (IBRD, 1974); Appraisal Report of the Second Education Project in Bangladesh (IBRD, 1975); Appraisal Report of the Fourth Education Project in the Philippines (IBRD, 1976); Report of the Agricultural Universities Review Team (1978).

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## SECRETARIES

NANALAL CHAMANLAL MEHTA, ICS

*Born* : 17 November 1892. *Education* : Wilson College, Bombay, and Fitz William House, Cambridge; Graduated in Natural Sciences and Economics. *Professional Positions* : District Officer, United Provinces; Director of Agriculture, Land Records, Statistics; Inspector General of Registration; Secretary and officiating Vice-Chairman of the Imperial Council of Agricultural Research; Secretary, Industries and Education, United Provinces, Sugar Controller for India. *Publications* : Studies in Indian Paintings, Gujarati Painting in the 15th Century, Contribution of Island to Indian Culture and Bharatiya Chitrakala.

BHAGWAN SAHAY

*Born* : 15 February 1905. *Education* : B. Sc. (Allahabad), School of Oriental Studies, London. *Professional Positions* : Joint Magistrate, United Provinces (1929); Deputy Secretary, United Provinces (1936-1939); Superintendent, Census Operations (1939-1941); Secretary, Indian Council of Agricultural Research (1941-1943); Joint Secretary, Government of India (1944-45); Commissioner, Food and Civil supplies (1946-49); Chief Secretary, Uttar Pradesh (1949-51); Chief Commissioner, Himachal Pradesh (1951-52); Chief Commissioner, Bhopal (1952-54); Ambassador to Nepal (1954-59); Chief Commissioner of Delhi (1959-63); Governor of Himachal Pradesh (1961-66); Governor of Kerala (1966-67). *Recognition* : Padma Bhushan (1961).

SHYAM MOHAN SRIVASTAVA, ICS

*Born*: 13 July 1910. *Education* : Allahabad, Trinity College (Dub-

lin), Jesus College, Oxford. *Professional Positions* : Assistant Joint Magistrate, United Provinces (1934-38); Assistant Settlement Officer, Faizabad (1938-40); Settlement Officer, Farrukhabad (1940-42); Deputy Commissioner, Bara Banki (1942-43); services plated with the Government of India (1943); Additional Collector of Central Excise, North-Western India (1943-44); Secretary, Imperial Council of Agricultural Research (1944-45); Deputy Secretary, Department of Education, Health and Lands (1945); Secretary, Ministry of Agriculture (1945-47); Indian Embassy, USA; Secretary of Indian Delegation to FAO at Geneva (1947). *Publications* : Settlement Report on Faizabad and Farrukhabad, United Provinces Government, Report of the Indian Delegation to FAO (1947).

DR M. S. RANDHAWA, ICS

*Born*: 2 February 1909. *Positions*: Joined the Indian Civil Service on 23 September 1934 as Assistant Magistrate at Saharanpur; Joint Magistrate, Faizabad (1936-38), where he took active interest in rural development scheme of the U.P. Government and constructed a number of panchayat ghars; Joint Magistrate, Almora (1938-39), where he travalled extensively in the Kumaon Hills; Additional District Magistrate and Collector, Allahabad (1939-40); transferred to Agra (1940), where he was District Magistrate and Collecter; Deputy Commissioner, Rae Bareli (1942-45); it was war time, but he took lot of interest in rural development work; constructed a number of panchayat ghars and high schools with public support in the district; joined as Secretary of the Imperial Council of Agricultural Research, New Delhi in 1945, and served for a year.

TRILOKI NATH KAUL, ICS

*Born* : 8 February 1913. *Education* : B.A. Hons (Punjab); LL.B. (Allahabad); LL.M. (London); Fellow, Royal Society of Arts, London; Honorary Fellow, King's College, London University. *Professional Positions* : Secretary, Indian Council of Agricultural Research, Government of India (1945-47); First Secretary, Indian Embassy, Moscow (1946-49); First Secretary, Indian Embassy, Washington (1949-50); Deputy Secretary-General, Indian Delegation to UN (1947); Counsellor and Minister, Indian Embassy, Peking (1950-53); Joint Secretary, Ministry of External Affairs, Government of India (1953-56); Chairman, In-

ternational Commission, and Leader, Indian Delegation, Vietnam (1957-58); Ambassador to Iran (1958-60); Deputy and Agriculture High Commissioner, London (1960-62); Ambassador to the USSR and Mangolia (1962-66); Secretary, External Affairs Ministry, Government of India (1966-68); Foreign Secretary, Government of India (1968-72); Ambassador to USA (1973-77).

LALA SANT RAM MAINI, IAS

*Born* : 4 February 1904. *Education*: M.A. (History). *Professional Positions* : Punjab Education Department (before 1928); Extra Assistant Commissioner, Ludhiana (1928), Montgomery (1928), Jhang (1929-30), Sargodha (1931); Deputy Secretary to the Government of India, Ministry of Agriculture (1947).

J. V. A. NEHEMIAH

*Born* : June 1913. *Education* : M.A. (Madras). *Professional Positions* :Joined the Government Service (1937); Assistant Secretary (1947); Under-Secretary (1948) and Deputy Secretary (1951) in the Ministry of Food and Agriculture, Government of India; Secretary, Indian Council of Agricultural Research (1951-58); Extension Commissioner, Ministry of Food and Agriculture, Government of India (1958). The Council expanded the research schemes enormously; the Indo-American University sisterhood programme was started during his tenure, and the agricultural and veterinary colleges in India strengthened and expanded. *Major Contributions* : Responsible for the expansion of the Indian Council of Agricultural Research, initiation and execution of research schemes, building the basis for scientific, agricultural development and streamlining the ICAR publications and planning low-priced and useful literature for the farmers, and developing similar facilities in State Departments of Agriculture.

S. K. MIRCHANDANI

*Born* : 5 March 1909. *Educotion*: B.A. *Professional Positions* : Assistant Director of Civil Supplies and Assistant Secretary to the Government of Sind (1945-47); Private Secretary to the Union Minister for Food and Agriculture, Government of India (1948-50); Under-Secretary to the Government of India, Ministry of Food and Agriculture

(1951-54); Additional Secretary, Indian Council of Agricultural Research (1955-57); Secretary, Indian Council of Agricultural Research (1958-60); Deputy Secretary to the Government of India, Ministry of Agriculture.

ANAND SWAROOP BHATNAGAR

*Born* : 7 July 1909. *Education* : M. Sc. (Punjab). *Professional Positions* : Assistant Industrial Adviser, Department of Planning and Development (1944); Secretary to the Chief Commissioner of Delhi (1947); Under-Secretary to the Government of India, Ministry of Information and Broadcasting (1948), and Ministry of Transport (1955); Deputy Secretary, Additional Secretary, Secretary, Indian Council of Agricultural Research (1960-64); Deputy Secretary/Director/Joint Secretary, Ministry of Communications (1967-74). *Major Contributions* : Contributed to the formation of the Association of State Road Transport Undertaking; helped in setting up National Seeds Corporation.

K. P. SINGH, IAS

*Born* : 14 June 1922. *Education* : Agra. *Professional Positions*: Held several important posts such as Additional Development Commissioner; Special Secretary, Co-operative Department; District Magistrate, Varanasi; Sales Tax Commissioner and Transport Commissioner, in the U. P. Government; Secretary, ICAR (1972-77).

SURAIN SINGH DHANOA

*Born* : 2 September 1929. *Education* : B. Sc. (Jullundur); M.A. (Aligarh), LL.B. (Aligarh); Institute on Development Administration, University of Pittsburg, USA. *Professional Positions* : Collector and Magistrate, Shahbad, Bihar (1959-60); Deputy Secretary, Department of Finance, Government of Bihar (1961); District Magistrate, Dhanbad and Ranchi, Bihar (1961-67); Registrar of Co-operative Societies, Bihar (1967-68); Senior Deputy Director, National Academy of Administration, Government of India, Mussoorie (1968-71); General Manager, Super Bazar Co-operative Stores Ltd, New Delhi (1972-75); Food Commissioner and Principal Secretary (1975-76), Health Comissioner and Principal Secretary (1976-77), Additional Chief Secretary

and Principal Secretary (1977), Government of Bihar; Secretary, Indian Council of Agricultural Research, New Delhi (1977-todate).

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## APPENDIX 3

## AGRICULTURAL COMMISSIONERS AND ANIMAL HUSBANDRY COMMISSIONERS

SIR BRYCE C. BURT, CIE, MBE, B.Sc., IAS

*Education* : B. Sc. (London). *Professional Positions* : Assistant Lecturer, Liverpool University (1902-4) Assistant Government Chemist and Lecturer on Tropical Agriculture, Trinidad (1904-8); Deputy Director of Agriculture, Kanpur (1908-21), officiated as Director of Industries (1912-15); Secretary, Indian Central Cotton Committee (1921-28); Director of Agriculture, Governments of Bihar and Orissa (1928-29); Agricultural Expert to the ICAR (1929-35); Vice-Chairman, Imperial Council of Agricultural Research (1935). *Major Contribution* : Started the Agricultural Marketing Organization. *Recognitions* : Adviser to the Indian Delegation to the Imperial Economic Conference, Ottawa (1932); Adviser, Indian Trade Delegation (1937). *Awards*: Kaiser-i-Hind (1912), MBE (1919), CIE (1930) and Knighthood (1936).

F. J. F. SHAW, CIE, D.Sc., ARCS, FLS, IAS

*ProfessioanlPositions* : Joined the Indian Agriculture Service (1980) as supernumerary Mycologist; Second Mycologist and then Imperial Economic Botanist, IARI; Joint Director (1929-34) and Director, Indian Agricultural Research Institute (1934); officiated as Agricultural Expert, Imperial Council of Agricultural Research. Died : 29 July 1936.

WILLAIM BURNS, CIE, D.Sc.

*Education* : B.Sc. (Edinburgh); Ph.D. (Edinburgh). *Professional Positions* : Assistant Lecturer, University College of Reading (1907-8); joined Indian Agricultural Service as Economic Botanist (1908); Professor of Botany, College of Agriculture, Poona; joined military service (1910); Principal, College of Agriculture, Poona (1922); Director of

Agriculture, Bombay Province (1932); Agricultural Expert, Government of India (1936), later designated Agricultural Commissioner with the Government of India. *Recognition* : President, Indian Society of Genetics and Plant Breeding. *Awards* : CIE by the Government of India (1939). *Publications* : Edited Sons of the Soil; wrote a section in The Maratha Cultivator; and published many papers on agricultural, botanical and horticultural matters.

RAM LAL SETHI

*Born* : 20 April 1894. *Education* B. Sc. Agric. (Edinburgh), M.Sc. Botany (Lahore). *Professional Positions* : Selected for the Indian Agricultural Service (1921); Economic Botanist to the Government of United Provinces (1922-36); Secretary Adviser to Sir John Russell; Director, Rothamstead Agricultural Institute, England, who reviewed the research work of the ICAR (1936-37); Assistant Agricultural Commissioner, Government of India (1937-40); Professor of Agriculture and Principal, Government Agricultural College, Kanpur (1941); Cane Commissioner to the Government of United Provinces (1941-45); Director of Agriculture, U. P. for a short while and later in Sind (1945-47); Agricultural Commissioner to the Government of India (first Indian) (1947-52); Principal, College of Agriculture, Banaras Hindu University, Banaras (1952); Director, Institute of Plant Industry, Indore (1953-57); Agricultural Adviser, National Council of Applied Economic Research (1957). *Awards* : Rai Bahadur (1937). *Publications* : About 24 scientific papers on different subjects of agriculture.

B. N. UPPAL

*Born* : 28 June 1900. *Education* : Ph. D. (USA), D.Sc. (*h. c.*) Punjab Agricultural University. *Professioanl Positions* : In USA : Fellow, Iowa Experiment Station. In India : Plant Pathologist to the Bombay Government and Professor of Plant Pathology, College of Agriculture, Poona; Principal, College of Agriculture, Poona; Director of Agriculture (Research and Education), Bombay; Director of Agriculture, Bombay; Agricultural Commissioner with the Government of India; President, Indian Central Tobacco Committee; President, Indian Lac Cess Committee; Chairman, Committee on Survey and Reclamation of Wastelands in India; Agricultural Adviser, Punjab Government (honorary); Consultant in Agriculture, Rajasthan Government (honorary); Member,

State Planning Board, Haryana; part-time Member, State Planning Board, Punjab. *Recognitions* : Member of Gamma Sigma Delta, Phi Kappa Phi, Sigma Xi, USA; Member, Iowa Academy of Sciences; Fellow, Indian Academy of Sciences; Indian National Science Academy; Indian Phytopathological Society. *Honours* : Padma Shri; Centennial Award for distinguished service by Iowa State University (1958).

J. S. PATEL

*Born* : 11 December 1905. *Education* : B. Sc. Agric., M.Sc. Agric., (USA), Ph. D. (Edinburgh). *Professional Positions* : First Oilseeds Specialist to the Government of Madras, Coimbatore (1930-38); first Director of Jute Agricultural Research, Dacca (1938-44); first Principal, Bihar Agricultural College (1944-49); Director of Agriculture, Bihar (1949-55); Adviser (Agriculture), Ministry of Community Development (1955-59); Agricultural Commissioner to the Government of India, Ministry of Food and Agriculture, and the Indian Council of Agricultural Research (1959-64); first Vice-Chancellor, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (1964-68). *Recognitions* : Member, National Planning Council; President, Indian Society of Agricultural Engineers; Consultant to the Ministry of Agriculture and Irrigation, Government of India, and to the Government of Gujarat on Narmada Irrigation Project; Member, Agricultural Credit Board, Reserve Bank; Member of Boards of Management of Pantnagar, Assam, Bihar and Gujarat Universities; Director, Paushak Ltd, Miles India Ltd, Dynachem Pvt Ltd and Agro-Consultants Ltd; member of a number of scientific societies and bodies; served as a member of the Governing Bodies of the ICAR, Indian Institute of Community Development, and evaluation committees for evaluating the Punjab Agricultural University, Agricultural Institute, Anand, Indian Agricultural Research Institute, New Delhi, and other institutes; Director of Fertilizer Corporation of India, Alembic Glass Industries Ltd, Shreno Ltd and Agricultural Finance Corporation Ltd; represented India in the FAO. *Honours and Award* : Padma Shri (1965).

S. M. SIKKA

*Born* : 1 August 1906. *Education* : B. Sc. Agric.; Associate, IARI, Ph. D. (London). *Professional Positions* : Research Assistant (1926-28), Assistant Cotton Botanist (1940-47), Cerealist (1947), Economic

Botanist, Department of Agriculture, Government of Punjab (1947-48); Deputy Adviser, Ministry of Food and Agriculture, Government of India (1952-54); Head, Division of Botany, IARI (1954-58); Additional Agricultural Commissioner and Agricultural Commissioner, Government of India (1958-64). Died : 8 April 1968.

A. B. JOSHI

*Born* : 17 November 1916. *Education* : Associate, IARI; Ph. D., Cambridge. *Professional Positions* : Research Assistant (1940-45), Assistant Botanist (1945-47), Assistant Cytogeneticist (1947-54), Geneticist (1954-58), Professor of Botany (1958-59), Head, Division of Botany (1959-61), Dean, Postgraduate School (1961-65); Director, Indian Agricultural Research Institute, New Delhi (1965-66); Deputy Director-General (Crop Sciences), ICAR (1966-70); Project Manager, UNDP/FAO Project on Improvement of Field Crop Productivity, Egypt, under the Food and Agriculture Organisation (1970-71); Director, IARI, New Delhi (1972-77); Vice-Chancellor, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra (1977-todate). *Positions in Scientific and other Organizations* : Fellow, Indian Botanical Society; President, Indian Society of Genetics and Plant Breeding (1962); Secretary, Indian National Science Academy (1972-76); Fellow, Maharashtra Academy of Sciences. *Honours and Awards* : Marathi Vidnyan Parishad (1971); Padma Shri (1976); Borlaug Award (1976). *Recognitions* : Member, International Team for Reorganisation of Agricultural Research, Indonesia (1969); Member, External Research Reveiw Team, International Wheat and Maize Research Centre, Mexico (1972); Member, International Board for Plant Genetic Resources, Rome, Italy (1974-77, 1978-80); Member, Technical Advisory Committee of the Consultative Group on International Agricultural Research, Rome, Italy (1977-78); Member, Committee of Scientific Terminology in Hindi, Ministry of Education, Government of India; Chairman, Panel on Text Book of Agriculture, National Council of Education, Research and Training, New Delhi; Member, Panel on Agricultural Education, Education Commission of India (Kothari Commission); Member, Board of Directors, National Seeds Corporation, New Delhi; Member, Board of Directors, Central State Farms Corporation of India; Member, National Committee on Science and Technology, Government of India; Member, Board of Management, Andhra Pradesh Agricultural University, Hyderabad; Chairman, Board of Directors, Maharashtra State Seeds Corporation, Akola; Member,

Board of Directors, Bank of Maharashtra, Pune; Member, Board of Directors, Indians Drugs Research Association, Pune. *Publications*: Over 300 publications (including a monograph on sesame and cotton).

J. S. KANWAR

*Born* : 10 December 1922. *Education* : M. Sc. Agric. (Lyallpur), Ph. D. (Australia). *Professional Positions* : Professor of Soil Science (till 1962) and Director of Research, Punjab Agricultural University, Ludhiana (1962-66); Deputy Director-General (Soils, Agronomy, Engineering), ICAR (1966-73); Associate Director, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad (1973-todate). *Awards and Honours* : Rafi Ahmed Kidwai Memorial Prize (1965); Borlaug Award (1978); Fellow, Indian National Science Academy (1975); and Honorary Member, Indian Soil Science Society (1977), President, International Society of soil Science (1978-82). *Recognitions*: President, Indian Society of Soil Science (1970-72); President, International Symposium on Soil Fertility Evaluation, New Delhi (1971); President, Arid Zone Workers' Association (1969-72); Chairman, Inter-Governmental Working Group on Soil Degradation organized by FAO at Rome under the aegis of UN Committee on Human Environments; Vice-Chairman, Conference of the Commonwealth Agricultural Bureaux; London; Vice-Chairman, Commission VI, International Society of Soil Science (1964-68, 1969-74); Member, Advisory Committee of UNESCO on Natural Resources (1967, 1969, 1971); Consultant to Asian Development Bank, Manila (1973); Consultant to FAO on Water Management in Sri Lanka (1973); Consultant to UNDP on Rainfed Agriculture in Indonesia (1979); Member, Indian National Man and the Biosphere Committee of the National Committee on Environmental Planning and Co-ordination.

T. R. MEHTA

*Born* : 1 July 1908. *Education* : Associate, IARI (New Delhi), Ph.D. (USA). *Professional Positions* : Research Assistant (1932-36), Assistant Paddy Specialist (1936-39), Assistant Botanist (1939-46), Economic Botanist, Government of Uttar Pradesh (1948-55); Principal, Agricultural College, Gwalior, and Joint Director of Agriculture (Res. and Edn), Government of Madhya Pradesh (1955-58); Director, Farm Advisory Unit, Directorate of Extension, Ministry of Food and Agriculture,

Government of India (1959-66); Dean of Agriculture, Andhra Pradesh Agricultural University, Hyderabad (1966-69); Deputy Director-General (Crop Sciences), ICAR (1970-73); Adviser, Orissa University of Agriculture and Technology, Bhubaneshwar (1974-76); Adviser (Research), Rajendra Agricultural University, Bihar (1978). *Awards* : Wordhouse Memorial Prize for best essay on a plant breeding subject (1931). *Recognition* : President, Indian Society of Genetics and Plant Breeding (1955). *Publications* : Over 100 original research papers and technical articles.

D. R. BHUMBLA

*Born* : 6 December 1921. *Education* : B.Sc. Agric. (Punjab), M.Sc. Agric. (Punjab), Ph. D. Agron. (USA). *Professional Positions* : Professor and Head, Punjab Agricultural University, Ludhiana, Hissar (1964-66); Dean, College of Agriculture, Punjab Agricultural University, Hissar (1966-69); Director, Central Soil Salinity Research Institute, Karnal (1969-74); Deputy Director-General (SAE), ICAR (1974-78). *Awards* : Rafi Ahmed Kidwai Award (1972-73); Guinness Award for Scientific Achievements (1978). *Recognitions* : Vice-President, International Society of Soil Science; Chairman, Working Group on Desertification, ISSS; President of Indian Society of Soil Science; Member, Indo-US Science and Technology Commission on Agriculture; Member, National Committee for International Hydrological Programme of CSIR; Member, Water Resource and Quality Resource Committee of Central Board for the Prevention and Control of Water Pollution; Member, National Committee on Environmental Planning and Coordination Committee of the Department of Science and Technology; Member, Steering Committee of the Potash Research Institute of India; Director, State Farms Corporation, New Delhi; Director, National Seeds Corporation of India; Vice-Chairman of various commodity committees of the Government of India (Department of Agriculture). *Publications* : More than 100 publications.

SUKHDEV SINGH

*Born* : November 1919. *Education* : M. Sc. Agric. (Panjab University); Ph. D. (USA), *Professional Positions* : Economic Botanist, Punjab Government; Director of Research, PAU, Ludhiana (1964-74); Deputy Director-General, ICAR (1974-79);

Vice-Chancellor, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (1979-todate). *Recognitions*: Member, Board of Trustees, International Rice Research Institute; Chairman, Central Insecticides Registration Committee; Chairman, Central Subcommittee on Release of Varieties; Ministry of Agriculture and Irrigation; Chairman Central Subcommittee on Crop Standards and Modification, Ministry of Agriculture and Irrigation; Chairman, Postgraduate Agricultural Education and Research Board, Guru Nanak Dev University, Amritsar; Member, Board of Directors of the State Farms Corporation of India; Member, Central Seed Certification Board, Ministry of Agriculture and Irrigation; Member, General Council of the Indian Standards Institution and its Sectional Committee; Member, Academic Council of Guru Nanak Dev University, Amritsar; Member, Syndicate of Guru Nanak Dev University, Amritsar; Dean, Faculty of Agriculture of Guru Nanak Dev University, Amritsar. Besides, he had been a member of the Governing Body and Advisory Board of the ICAR, etc.

NARINDER SINGH RANDHAWA

*Born* : 13 March 1927. *Education* : M. Sc. Agric., Ph. D. (USA). *Professional Positions* : Research Assistant, Central Water and Power Commission (1948-49); Research Assistant, Director Agriculture, Punjab (1949-57); Agricultural Analytical Chemist/Assistant Professor (1957-64), Associate Professor of Soil Science (1964-67), Punjab State Agricultural Department; Professor of Soil Science (1967-72), Senior Professor of Soil Science (1972-73), Director of Research/Dean, Agriculture (1973-75), Special Director of Research, Punjab Agricultural University (1975-79); Deputy Director-General (SAE), ICAR (April 1979-todate). *Awards and Honours* : The best paper award by the Fertilizer Association of India for 1975; Rafi Ahmed Kidwai Memorial Prize. *Recognitions* : Member, American Society of Agronomy (1961-65); Member, Australian Society of Soil Science (1971-73); Member, Indian Society of Soil Science; Member, Indian Society of Horticulture; Member, Indian Society of Agronomy; Member, Indian Society for Nuclear Techniques in Agriculture and Biology; Member, Indian Standard Institute Committee No. CDC-24; Member, Regional Committee for Sub-Humid Satluj-Ganga Alluvial Plains of India (ICAR Committee); Member, Standing Committee of Experts on Manures and Fertilizers, Ministry of Food and Agriculture, CD and Co-operation, Department of Agriculture, Government of India, New Delhi; Member,

Subcommittee of Chemists to Review the Methods of Sampling for Analyses of Fertilizers, Ministry of Agriculture, New Delhi; Member, Improvement of the Efficiency of Fertilizer Use in Different Crops in the Country Task Force, ICAR; Member, Subcommittee on Soil and Soil Plant Relations of the National Committee on Soil Science and Technology, Forest Research Institute and College, Dehra Dun.

Invited to contribute a paper on "Micronutrients" at the International Symposium of "Soils and Rice" held at International Rice Research Institute, Philippines. *Publications* : About 250 research papers.

COI. SIR ARTHUR OLVER

*Professional Positions*: The first Animal Husbandry Commissioner with the Government of India (1930-38). *Major Contributions*: Cataloguing of cattle in India and unfolding their latent milking qualities; introduced the Institution of Investigation Scheme; organized the first All-India Cattle Show (1938). *Publication*: A Brief Survey of Some Important Breeds of Cattle in India.

MR P. J. KERR, MRCVS, IVS

*Born*: 2 February 1885. *Education*: Diploma in MRCVS (1906). *Professional Positions*: Joined the Indian Civil Veterinary Department, Government of India (1911); Superintendent, Civil Veterinary Department, Government of Madras and Bengal (1912-18, expcept for a break in 1915-19 for military service); Animal Husbandry Commissioner, Government of India (1938). *Major Contributions*: Introduced 'goat tissue vaccine alone' as the routine methord for controlling rinderpest; established an All-India Cattle Show Society.

FRANK WARE, FRCVS, IVS, FNI, CIE,

*Born*: 22 February 1886. *Education*: FRCVS. *Professional Positons*: Civil Veterinary Department of Government of India (1907-11), Head, Civil Veterinary Department, Madras Presidency (1911); first Veterinary Research Officer (1926), Officiating Director, Imperial Institute of Veterinary Research (1926); Principal, Madras Veterinary College; Veterinary Adviser to the Government of Madras; Director, IIVR (1929-38); Animal Husbandry Commissioner with the Government of India and Imperial Council of Agricultural Research (1938-44); first

Animal Husbandry Commissioner of United Provinces (1944-47). *Awards*: CIE; knighthood. *Achievements*: Boosted research on rinderpest, bovine tuberculosis, Johne's disease, Ranikhet disease nasal granuloma, etc. Died: 6 December 1968.

G. WILLIAMSON, CBF, MRCVS, DVSM

*Education*: MRCVS, DVSM. *Professional Positions* : Animal Husbandry Commissioner. *Publications*: An Introduction to Animal Husbandry Tropics in the along with W.J.A. Payne.

RAI BAHADUR P. N. NANDA

*Professional Positions*: Worked for 30 years in various capacities in India (holding the post of Director of Animal Husbandry in Punjab and Maharashtra) before joining the Government of India as Animal Husbandry Commissioner (1947-56). *Major Contributions*: Improved the Dhani breed of cattle and the sheep and camels; laid the foundation for the development of Hariana cattle and Hissardale sheep, initiated the Rinderpest-Eradication Plan; and started four new veterinary colleges.

LAXMI SAHAI

*Professional Positions*: Research Officer (1932-38 and 1941-44); Director, of Animal Husbandry and Veterinary Services, Bombay State; Director, Indian Veterinary Research Institute, Izatnagar (1954-57); Animal Husbandry Commissioner, Government of India (1957-64). *Major Contributions*: Focussed attention on bovine tuberculosis in India. *Recognitions*: Chairman, Key-Village Expert Committee; Member, FAO and WHO Panel on Veterinary Education; Member, Joint Indo-American Teams; Member, Cummings Committee of the ICAR which drew up a blueprint for agricultural universities in India. Died: 3 July 1971.

P. BHATTACHARYA

*Born*: 1910. *Education*: B.Sc. Hons, M.Sc. (Calcutta), Ph. D. (Edinburgh). *Professional Positions*: Assistant Research Officer (1942). Research Officer (1944), Head, Division of Animal Genetics (1945-59), Assistant Director, Indian Veterinary Research Institute (1959); Livestock Development Adviser to the Government of India (1960-64);

Animal Husbandry Commissioner with the Government of India (ICAR) (1964-66); Animal Husbandry Commissioner with the Government of India (1966). *Awards*: Spallanzani Medal for outstanding contribution in the field of Artificial Insemination and Animal Husbandry. *Positions in Scientific and other Organizations*: Fellow of the National Institute of Sciences of India (1956); Member of the Standing Committee of the International Society of Animal Reproduction and Artificial Insemination (1956); Honorary Foreign Fellow of the Italian Society of Animal Husbandry (1957); Sectional President (Zoology), Indian Science Congress Association (1958); Official Secretary, Central Council of Gosamwardhana (in addition to duties of Livestock Development Adviser/AHC) (1961-69); Sectional Vice-President, 5th International Congress on Animal Reproduction and Artifical Insemination (1964); President, Indian Poultry Science Association (1965-69); Chairman, FAO/OIE Regional Conference on Animal Epizootics (1964); President, Indian Dairy Science Association (1968-73); President, Indian Association of Animal Production (1969-73); Chairman, Genetic Association of India; Member, FAO Panel on Animal Breeding and Climatology; Member, FAO Expert Panel on Veterinary Education; Chairman, Animal Breeding Committee panel of the Indian Council of Agricultural Research (1964-72); Member, National Commission on Agriculture, Government of India (1970-76); FAO Consultant on Buffalo Husbandry (1971), President, Indian Society of Animal Genetics and Breeding (1979); Member, National Dairy Development Board (1965-77); Director, Indian Dairy Corporation (1970-77); Member (part-time), Rajasthan Planning Board (1975-78); Member, Board of Mangement, Rajendra Agricultural University, Bihar; Member, Board of Management/Council of Bidhan Chandra Krishi Vishwa Vidyalaya, West Bengal (1974); Member, National Academy of Agricultural Research Mangement (1978). *Publications*: About 100 scientific articles; also contributed chapters in many books.

KRISHNASWAMI KILARAIYA

*Born*: 26 June 1920. *Education*: B.Sc., ARRSC; Ph. D. *Professional Positions*: Head (Dairy Bacteriology), Indian Dairy Research Institute, Bangalore (1948-59); Director, National Dairy Research Institute, Karnal (1955-65); Dairy Development Advisor to Government of India, Ministry of Food and Agriculture, New Delhi (1965-66); Deputy Director-General (Animal Sciences), ICAR (1966-70); Techni-

cal Manager, Coca Cola Export Corporation. New Delhi (1970-73); Team Leader, FAO/UNDP Regional Projection Livestock Development Survey, FAO Regional office. Bangkok (1973-76). *Recognitions*: Professor Emeritus (Dairy Technology), University of Agricultural Sciences, Bangalore; Honorary Consultant, Assam Institute for Rural Development, Chairman Task Forces for Buffalo Research Institute, Goat Research Institute and Bureau of Animal Genetic Resources.

B. K. SONI

*Born*: 8 April 1928. *Education*: B.V.Sc. (Hissar), Ph.D. (USA). *Professional Positions*: Professor of Physiology, Veterinary College, Bikaner (1955-61); Head, Department of Physiology and Pharmacology, Uttar pradesh Agricultural University, Pantnagar (1961-64); Dean, College of Veterinary Medicine, Uttar Pradesh Agricultural University, Pantnagar (1964-71); Deputy Director-General (Animal Sciences), ICAR (1971-1979). *Recognitions*: President, Indian Association for Animal Production; Fellow, National Academy of Sciences of India; Member, Government of India Delegation of Animal Scientists to USSR; Member, Indian Team for WHO Seminar on Veterinary Public Health for Senior Administrators; Member, Indian Delegation on Agriculture to Iraq; official delegate at the Seminar on Agricultural Policy and Agricultural Education convened by the Bangladesh Government; representative of the Government of India at the meeting of AGRIS and the Developing Countries held at the FAO Headquarters, Rome; participant at the International Symposium on Animal Research in Tokyo; representative of the Government of India at the FAO Expert Consultation on Animal Production and Health at Copenhagen; participant at the Seminar on Evaluation and Mapping of Tropical African Rangeland, held under the auspices of International Livestook Centre for Africa, at Bamako (March 1975); leader of the Indian delegation and Vice-Chairman, Commonwealth Agricultural Bureaux Review Conference, London (1975); attended the FAO Expert Consultation on International Buffalo Research Needs at Singapore (March 1976); member of the Indian delegation to Norway (September 1976); participant at the Animal Review Conference of Commonwealth Agricultural Bureaux, London; and participant at the Regional Workshop on "Inventory of Livestock Resources in Asia" held in Manila, Philippines. *Publications*: Published about 50 research papers.

FAZIL-I-HUSSAIN

*Born*: 14 June 1877. *Education*: B. A. (Lahore). *Professional Positions*: Advocate (1905). Took part in the Lahore and Rawalpindi riots and passed the Punjab Regulation of Accounts Bill; Member, Viceroy's Executive Council for the Department of Education, Health and Lands (1930-35); promoted the establishment of the Imperial Council of Agricultural Research, and later a marketing section (1943) to the Council; successfully strived for founding the Indian Agricultural Reserch Institute at New Delhi (1935). Died: 9 July 1976.

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## APPENDIX 4

## VICE-CHANCELLORS OF AGRICULTURAL UNIVERSITIES AND THEIR TENURES

| | University/Vice-Chancellor | Date From | To |
|---|---|---|---|
| 1 | *Punjab Agricultural University* | | |
| | Mr P. N. Thapar | 01-03-1962 | 24-01-1968 |
| | Dr M. S. Randhawa | 28-10-1968 | 27-10-1976 |
| | Dr Sukhdev Singh | 07-11-1976 | 29-11-1976 |
| | Dr A. S. Cheema | 17-12-1976 | todate |
| 2 | *Indian Agricultural Research Institute* | | |
| | Dr M. S. Swaminathan | 09-07-1966 | 14-01-1972 |
| | Dr A. B. Joshi | 02-06-1972 | 22-01-1977 |
| | Dr H. K. Jain | 22-01-1977 | todate |
| 3 | *Mahatma Phule Krishi Vidyapeeth* | | |
| | Mr H. G. Patil | 29-03-1968 | 16-08-1971 |
| | Mr B. R. Sawant | 17-08-1971 | 25-01-1972 |
| | Mr M. S. Pawar | 26-01-1972 | 24-01-1977 |
| | Dr A. B. Joshi | 25-01-1977 | todate |

4 *Himachal Pradesh Krishi Vishwa Vidyalaya*

| | | |
|---|---|---|
| Dr R. K. Singh | 01-01-1971 | 02-09-1975 |
| Dr B. S. Jogi | 02-09-1975 | 22-07-1977 |
| Dr S. K. Chauhan (Acting) | 22-07-1977 | 13-10-1977 |
| Dr L. S. Negi | 13-10-1977 | 08-09-1978 |
| Dr H. R. Kalia | 09-09-1978 | todate |

5 *Vidhan Chandra Krishi Vishwa Vidyalaya*

| | | |
|---|---|---|
| Prof. S. D. Chattopadhayay | 01-09-1974 | 20-04-1978 |
| Dr M. M. Chakrobarty | 02-01-1978 | todate |

6 *Chandra Shekhar Azad University of Agriculture and Technology*

| | | |
|---|---|---|
| Prof. K. N. Kaul | 01-03-1975 | todate |

7 *Tamil Nadu Agricultural University*

| | | |
|---|---|---|
| Dr G. Rangaswami | 01-06-1971 | 29-08-1978 |
| Mr A. Venkataraman | 30-08-1978 | todate |

8 *Orissa University of Agriculture and Technology*

| | | |
|---|---|---|
| Mr M. C. Pradhan (President) | 29-09-1962 | 28-09-1965 |
| Dr K. Ramiah (President/VC) | 29-09-1965 | 16-03-1968 |
| Dr B. Samantrai | 16-03-1968 | 06-06-1971 |
| Dr C. N. Nanda | 16-06-1971 | 16-07-1973 |
| Mr J. Das | 16-07-1973 | 14-09-1976 |
| Dr K. Kanungo | 15-09-1976 | todate |

9 *Kerala Agricultural University*

| | | |
|---|---|---|
| Mr N. Chandrabhanu | 11-03-1971 | 16-02-1973 |
| Dr C. T. Peter | 17-02-1973 | 23-04-1973 |
| Dr C. M. Jacob | 24-04-1973 | 06-07-1975 |
| Mr N. Kaleeswaran | 07-07-1975 | todate |

10 *Konkan Krishi Vidyapeeth*

| | | |
|---|---|---|
| Mr M. S. Pawar | 18-07-1972 | 25-10-1974 |
| Mr S. V. Chavan | 26-10-1974 | 25-10-1977 |
| Dr P. V. Salvi | 26-10-1977 | todate |

11 *Jawaharlal Nehru Krishi Vishwa Vidyalaya*

| | | |
|---|---|---|
| Dr J. S. Patel | 01-01-1964 | 19-03-1968 |
| Dr L. S. Negi | 20-03-1968 | 31-05-1972 |

| | | | |
|---|---|---|---|
| | Mr S. C. Verma | 08-05-1972 | 25-10-1972 |
| | Dr C. Thakur | 26-10-1972 | 30-03-1975 |
| | Mr E. B. Reinboth | 31-03-1975 | 19-09-1975 |
| | Dr R. L. Kaushal | 20-09-1975 | 09-02-1978 |
| | Mr S. N. Sakalle | 10-02-1978 | 31-05-1978 |
| | Dr R. V. Ramakrishna | 01-06-1978 | 15-03-1979 |
| | Major A. B. Sharma | 16-03-1978 | todate |
| 12 | *Assam Agricultural University* | | |
| | Dr S. R. Barooah | 19-03-1969 | 11-10-1971 |
| | Dr R. N. Hazarika (Acting) | 11-10-1971 | 01-06-1972 |
| | Dr L. S. Negi | 01-06-1972 | 11-06-1977 |
| | Mr P. S Majumdar | 11-06-1977 | 04-01-1979 |
| | Dr M. N. Borha (Acting) | 17-04-1978 | 31-03-1979 |
| | Dr D. N. Borthakur | 31-03-1979 | todate |
| 13 | *Narendra Dev University of Agriculture and Technology* | | |
| | Mr A. D. Pande | 10-10-1975 | 09-10-1977 |
| | Dr A. S. Yadav | 25-10-1977 | todate |
| 14 | *University of Agricultural Sciences* | | |
| | Dr K. C. Naik | 12-06-1964 | 11-06-1973 |
| | Dr H. R. Arakeri | 12-06-1973 | 1979 |
| 15 | *University of Udaipur* | | |
| | Mr G. B. K. Hooja | 05-07-1962 | 20-11-1963 |
| | Dr G. S. Mahajani | 20-11-1963 | 03-01-1972 |
| | Mr S. P. Singh Bandhari | 03-01-1972 | 04-07-1972 |
| | Mr L. R. Shah | 04-07-1972 | 28-03-1973 |
| | Dr P. S. Lamba | 29-03-1973 | 18-07-1977 |
| | Dr Ranbir Singh | 18-07-1977 | todate |
| 16 | *Marathwada Agricultural University* | | |
| | Mr L. S. Sundara Rajan | 31-05-1972 | 04-06-1974 |
| | Mr L. Sreenivas (Acting) | 05-06-1974 | 09-01-1975 |
| | Dr D. K. Salunke | 10-01-1975 | 31-01-1976 |
| | Dr V. S. Khuspe (Acting) | 01-02-1976 | 14-07-1977 |
| | Dr V. S. Khuspe | 15-07-1977 | todate |

17 *Haryana Agricultural University*

| | | |
|---|---|---|
| Mr A. L. Fletcher | 02-02-1970 | 06-02-1974 |
| Mr N. N. Kashyap | 06-02-1974 | 30-09-1977 |
| Dr P. S. Lamba | 01-10-1977 | todate |

18 *G. B. Pant University of Agriculture and Technology*

| | | |
|---|---|---|
| Dr K. A. Stevenson | 01-12-1959 | 02-01-1964 |
| Dr N. K. Anant Rao (Acting) | 02-01-1964 | 20-12-1964 |
| Raja Bajrang Bahadur Singh Bhadri | 20-12-1964 | 18-01-1966 |
| Dr D. P. Singh | 28-01-1966 | 20-01-1975 |
| Mr S. P. Pande | 20-01-1975 | 20-04-1977 |
| Dr K. G. Goallakota (Acting) | 20-04-1977 | 30-09-1977 |
| Dr I. P. Singh (Acting) | 30-09-1977 | 22-10-1977 |
| Dr Dharam Pal Singh | 22-10-1977 | 31-07-1978 |
| Mr N. S. Mathur | 01-08-1978 | todate |

19 *Andhra Pradesh Agricultural University*

| | | |
|---|---|---|
| Mr O. Pulla Reddi | 10-07-1964 | 01-06-1972 |
| Mr M. R Pai | 01-06-1972 | 31-08-1974 |
| Dr C. Krishna Rao | 01-09-1974 | 06-11-1978 |
| Dr J. Ragotham Reddy | 06-11-1978 | todate |

20 *Punjabrao Krishi Vidyapeeth*

| | | |
|---|---|---|
| Mr L. N. Bongirwar | 01-07-1969 | 09-10-1972 |
| Mr N. Gopalakrishna | 10-10-1972 | 02-06-1978 |
| Mr D. N. Capoor | 02-06-1978 | 02-07-1978 |
| Dr B. A. Chaugule | 03-07-1978 | todate |

21 *Gujarat Agricultural University*

| | | |
|---|---|---|
| Mr V. R Mehta | 01-02-1972 | 31-10-1978 |
| Mr Ishwarbhai J. Patel | 01-02-1978 | todate |

22 *Rajendra Agricultural University*

| | | |
|---|---|---|
| Mr S. K. Chakravarty | 03-12-1970 | 31-03-1973 |
| Prof. S. C. Mandal | 31-03-1973 | 24-05-1974 |
| Dr Asharfi Ram (Acting) | 24-05-1974 | 19-06-1974 |
| Prof. S. K. Mukerji | 20-06-1974 | 10-03-1976 |
| Mr T. P. Singh | 14-04-1976 | 17-01-1976 |
| Prof. S. P. Sinha (Acting) | 11-02-1976 | 14-04-1976 |
| | 13-03-1976 | 13-04-1976 |

| | | |
|---|---|---|
| Dr D. P. Singh | 09-06-1976<br>19-01-1977 | 18-01-1977<br>todate |

## APPENDIX 5

## AWARD WINNERS IN AGRICULTURE AND ANIMAL SCIENCES RESEARCH

### RAFI AHMED KIDWAI MEMORIAL PRIZES FOR AGRICULTURAL RESEARCH

| *Year* | *Winners* | *Subject of Research* |
|---|---|---|
| 1957 | Dr B. P. Pal | Agricultural Botany |
| | Dr L. B. Singh | Horticulture |
| | Mr R. D. Tripathi | |
| | *Mr M. R. Chandrasekhra* | *Dairying* |
| | Dr M. Swaminathan | |
| | Dr D. S. Bhatia | |
| | Dr V. Subramanyam | |
| 1958, 1959 | No awards wree given | |
| 1960, 1961 | Dr H. C. Srivastava, and | Horticulture |
| | Dr V. Subramanyam | |
| 1962, 1963 | No awards were given | |
| 1964, 1965 | Dr S. S. Bains | Agronomy |
| | Dr A. M. Micheal | Agricultural Engineering |
| | Dr J. S. Kanwar | Agricultural Chemistry |
| | Dr H. D. Srivastava | Animal Diseases |
| | Dr S. C. Dutt | Animal Diseases |
| | Dr Pushkarnath | Agricultural Botany |
| 1966, 1967 | Dr N. C. Dastane | Water Management |
| | Dr H. K. Jain | Genetics |
| | Dr V. Santhanam and | |
| | Mr R. Krishnamourthy | Plant Breeding |
| | Dr R. D. Asana | Plant Physiology |
| | Dr S. P. Ray-Chaudhuri | Plant Pathology |
| | Dr T. N. Ananthakrishnan | Entomology |
| | Dr A. Sreenivasan | Food Technology |
| | Dr Arivind Roy | Animal Physiology and |

| | | |
|---|---|---|
| | (since expired) | Biochemistry |
| | Dr S. S. Prihar | Soil Physics |
| 1968-69, | Dr. S. Y. Padmanabhan | Plant Pathology |
| 1970-71 | Dr Abrar M. Khan | Nematology |
| | Dr B. P. Ghildyal | Agricultural Physics |
| | Dr S. M. Sircar | Plant Physiology |
| | Dr S. Z. Qasim | Fisheries |
| | Late Dr S. C. Sen | Sugarcane Technology |
| | Dr J. V. Bhat | Microbiology |
| 1972-73 | Drs D. R. Bhumbla and I. P. Abrol (jointly) | Soil Science |
| | Dr H. K. Pande | Agronomy |
| | Drs C. V. Subramanian and T. N. Ramachandran (Jointly) | Mycology and Microbiology respectively |
| | Dr K. K. Nanda and Dr K. S. Gill (jointly) | Plant Physiology and Plant Breeding respectively |
| | Drs N. C. Ganguli, M. Bhosrekar and G. S. Majumdar (jointly) | Dairying |
| | Dr S. K. Mukherjee | Horticulture |
| | Mr C. R. V. Raman | Agric. Meteorology |
| | Dr (Mrs) Rajammal P. Devadas | Nutrition |
| | Drs V. G. Jhingran, V. R. P. Sinha and H. Chaudhuri (jointly) | Fisheries |
| | Prof. O. S. Bindra Prof. Harcharan Singh Prof. B. S. Sohi Mr G. S. Mavi Mr Amar Singh and Mr D. R. C. Bakhetia (jointly) | Entomology |
| 1974-75 | Dr B. I. Sundraraj | Fisheries |
| | Dr R. N. Mathur and Dr Ishwar Prakash (jointly) | Agricultural Ecology and Entomology |
| | Dr N. G. P. Rao | Plant Breeding and Genetics |
| | Dr Prem Narain and | Agricultural Economics and |

| | | |
|---|---|---|
| | Dr C. H. Hanumantha Rao (jointly) | Statistics |
| | Dr M. S. Naik | Biochemistry |
| | Dr N. S. Randhawa and Dr B. Ramamurthy (jointly) | Agricultural Chemistry and Soil Science |
| | Dr J. J. Chinoy and Dr B. C. Kundu (jointly) | Agricultural Botany and Plant Physiology |
| | Dr A. P. Bhatnagar and Mr T. H. Nirmal (jointly) | Agricultural Engineering |
| | Dr B. Chaudhury | Horticulture |
| | Dr S. P. Arora | Animal Sciences |
| | Dr R. P. S. Tyagi | Animal Sciences |
| | Dr Rajendra Prasad | Agronomy |
| | Mr E. S. Nambudiri, Mr. N. Krishnamurthy, Dr A. G. Methew, Dr Y. S. Lowis and Mr C. P. Natarajan (jointly) | Food Technology and Human Nutrition |
| 1976-77 | Dr S. R. Verma and | Agricultural Engineering |
| | Dr H. S. Chauhan (jointly) | Agricultural Engineering |
| | Dr T. N. Khoshoo | Horticulture |
| | Dr P. V. Dehadrai, Dr R. N. Pal, Dr N. K. Thakur, Mr V. K. Murugesan and Mr H. C. Pathak (jointly) | Fisheries |

## JAWAHARLAL NEHRU AWARD FOR POSTGRADUATE OUTSTANDING RESEARCH

| Year | *Winners* | *Subject of Research* |
|---|---|---|
| 1972 | Dr Hukam Chand Bansal | Genetics and Plant Breeding |
| | Dr Bishwa Nath Mittra | Agronomy |
| | Dr Y. P. Rao | Plant Bacteriology |
| | Dr P. M. Singh | Agricultural Engineering |
| 1973 | Dr S. Tara Mohan | Plant Breeding and Genetics |
| | Dr K. D. Singh | Agronomy |
| | Dr P. Vidyasekaran | Plant Physiology |

| | | |
|---|---|---|
| | Dr P. Rechard Masillamony | Veterinary Microbiology |
| 1974 | Dr B. Umanath Rao | Veterinary Virology |
| | Dr Nitya Nand Pathak | Animal Nutrition |
| | Dr S. Edison | Plant Pathology |
| | Dr Satya Prakash Yadav | Plant Breeding and Genetics |
| | Dr Vijya Singh Tommar | Soil Science |
| 1975 | Dr M. S. S. Reddy | Plant Breeding and Genetics |
| | Dr R. S. Tripathi | Agronomy |
| | Dr V. T. Raju | Agricultural Economics |
| | Dr V. Mumiyappa | Plant Pathology |
| | Dr R. N. Sharma | Veterinary Pathology |
| | Dr N. N. Bora | Animal Husbandry |
| 1976 | Dr K. V. Ramaiah | Genetics and Plant Breeding |
| | Dr. R. C. Maheshwari | Agricultural Engineering |
| | Dr K. Balaraman | Plant Pathology |
| | Dr V. A. Srinivasan | Virology |
| | Dr C. M. Aravindan | Fisheries Science |
| 1977 | Dr Ram Niwas | Agronomy |
| | Dr Mruthyunjaya | Agricultural Economics |
| | Dr D. R. C. Bakhetia | Entomology |
| | Dr Vijay Pal Singh | Agricultural Botany |
| | Dr Nawab Ali and Dr Sewa Ram Verma (jointly) | Agricultural Engineering |
| | Dr Virendra Kumar Srivastava | Animal Physiology |
| 1978 | Dr R. D. Iyer | Plant Breeding and Genetics |
| | Dr (Mrs) A. Sundara Bai | Fisheries |
| | Dr S. S. Zombade | Animal Nutrition |
| | Dr Srikant Kulkarni | Plant Pathology |
| | Dr N. G. Bhole | Agricultural Engineering |

## HARI OM ASHRAM TRUST AWARDS FOR 1974, 1975, 1976 AND 1977

| | *Winners* | *Subject of Research* |
|---|---|---|
| 1 | Mr V. S. Mathur, and Mr V. P. Kulsreshta, | Plant Breeding |

| | |
|---|---|
| Mr A. P. Sethi, Mr D. Satyawali, Mr J. S. Amavate and Mr J. B. L. Mathur (associates) | |
| 2 Dr E. A. Siddiq, and Mr R. P. Puri and Mr V. P. Singh (associates) | Plant Breeding and Genetics |
| 3 Dr O. P. Gautam and Mr Y. Bhatacharylu and Mr S. Dhar (associates) | Animal Health |
| 4 Dr B. S. Malik, and Mr S. K. Tanwani and Mr A. Bhatnagar (associates) | Veterinary Virology |
| 5 Mr K. Perumal | Agricultural Sciences |
| 6 Dr T. R. Chadha | Agricultural Sciences |
| 7 Dr A. G. Sathyanesan and Dr K. Alagaraswami (jointly) | Fisheries |
| 8 Dr O. Sreemannarayana and Dr B. S. Ramappa (jointly) | Animal Sciences |

## DR P. B. SARKAR ENDOWMENT PRIZE

| Year | *Winners* | *Subject of Research* |
|---|---|---|
| 1971-74 | 1 Dr L. M. Jeswani | Plant Breeding |
| | 2 Dr K. S. Nandpuri | Vegetable Breeding |
| | 3 Late Dr S. Pradhan | Entomology |
| 1974-77 | Dr K. Krishnamurthy | Agronomy |

## DR R. D. ASANA ENDOWMENT PRIZE FOR THE TERIENNIUM 1974-77

| *Winners* | *Subject of Research* |
|---|---|
| Dr Y. P. Abrol and | Plant Physiology |
| Mr S. H. Patil (jointly) | Plant Breeding |

## ICAR AWARDS FOR TEAM RESEARCH

| Year | *Winners* | *Subject of Research* |
|---|---|---|
| 1975-76 | Dr V. Santhanam, and his team of Mr C. T. Patel Mr B. H. Katarki, Prof. P. V. Marappan, Dr V. Sundaram, Mr R. Krishnamourthy, Dr K. V. Srinivasan, Mr G. Vedamourthy and Mr P. G. Oka | All-India Co-ordinated Cotton Improvement Project |

## DR RAJENDRA PRASAD PURASKAR

| *Prize* | *Winners* | *Book* |
|---|---|---|
| | 1974 | |
| I Prize | Dr Ambika Singh and Dr Mahabalram (jointly) | Boune Gehun ki Kheti |
| II Prize | Mr Dev Narain Pande | Pashupalan evam Pashu Chikitsa Vigyan |
| | 1975 | |
| I Prize | Dr Rattan Lal Agarwal | Beej Utpadan evam Pramanikaran |
| II Prize | Dr Ganesh Shankar Paliwal | Arthik Vanaspati Vigyan |
| | 1976 | |
| I Prize | Dr R. P. Saxena | Beej Sanshodhan |
| II Prize | Dr Binda Prasad Khare | Khadyanna Bhandaran evam Hanikarak Jeeva Niyantran |
| | 1977 | |
| I Prize | Dr S. D. Rai | Chare Utpadan evam Parirakshan |
| | 1978 | |
| II Prize | Dr Vishnu Mohan Bhan | Kharpatwar Niyantran |
| | Dr Ram Nath Singh | Phal Vigyan |
| | Dr N. L. Agarwal | Bharatiya Krishi ka |

| | |
|---|---|
| | Arthatantra |
| Dr P. C. Gupta and Dr R. L. Agarwal (jointly) | Beej Karyaki evam Beej Parikshan |

## KHETI PURASKAR

| *Year* | *Author* | *Article* |
|---|---|---|
| 1974-75 | Mr Sudama Singh | Ganne ko Phulane se Roken |
| | Mr Suresh Chandra | Pashuon ko Poshtik Pattiyan Khilayen |
| 1975-76 | Mrs Vimla Bahuguna | Mat Katto Jungle Mate Katto |
| | Mr Brij Bhushan Singh | Pashvon ne Kupothan ki Bimariyan |
| 1976-77 | Dr Gorakh Nath Singh and Mr Din Dyal Dohre (jointly) | Uttar Pradesh me Bundelkhand ki Banjar Bhumi aur uska Prabandh |
| | Dr Vishwa Nath and Mr Ashok Kumar (jointly) | Labhkari Dhandha Dairy Udyog |
| 1977-78 | Mr M. I. H. Farukhi and Mr Ram Kishor Tandon (jointly) | Grameen Vikas ke liye Beej Gond Udyog |
| | Mr B. B. Joshi | Pashuon men Kuposhan Janit Rog aur Ahar men Vitamin ki Kami |

## ICAR AWARDS FOR TEAM RESEARCH FOR THE BIENNIUM 1977-78

*Agricultural Sciences*

1 Dr D. N. Borthakur, and his team of
Dr S. P. Ghosh,
Dr R. N. Prasad,
Dr R. N. Rai,
Mr R. P. Awasthi,
Mr A. Singh,
Dr A. Varma,

*Fisheries*

1 Dr V. R. P. Sinha, and his team of
Dr R. D. Chakraborty,
Mr H. A. Khan,
Dr S. B. Singh,
Mr M. A. V. Lakshmanan,
Mr K. K. Sukumaran,
Mr M. V. Gupta,

Mr H. H. Dutta,
Mr B. S. Sharma and
Mr M. D. Singh

Mr K. N. Krishnamurthy,
Mr B. K. Sharma,
Mr R. M. Rao,
Mr K. G. Rao,
Mr D. P. Chakraborty, and
Dr P. M. Mathew

*Animal Sciences*

2 Mr P. Pillaiyar, and his team of
Mr B. S. Vasan,
Lt. Col. N. G. C. Iengar,
Mr G. Rajendran,
Mr V. Venkatesan,
Mr K. Ramachandran,
Mr K. M. Yusuf,
Mr R. V. Narayanasamy, and
Mr G. Ganesan

Dr R. P. S. Tyagi, and his team of
Dr D. Krishnamurthy,
Dr M. U. Kharole,
Dr D. N. Sharma and
Dr. A. K. Bhargava

FAKHRUDDIN ALI AHMED AWARD FOR AGRICULTURAL RESEARCH IN TRIBAL AREAS FOR THE BIENNIUM 1976-77

| *Winner* | *Subject* |
|---|---|
| Dr Bhag Singh | Agriculture |

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APPENDIX 6

## LIST OF ALL-INDIA CO-ORDINATED RESEARCH PROJECTS

### A. Agriculture

(a) *Food Crops*
1 Barley
2 Maize
3 Sorghum
4 Millets
5 Forage crops
6 National seed project

(b) *Commercial Crops*

1 Sugarcane
2 Sugarbeet
3 Cotton
4 Jute and allied fibres
5 Soybean
6 Tobacco
7 Cotton project assisted by World Bank

(c) *Horticultural Crops*

1 Fruits
2 Citrus
3 Tuber crops
4 Potato
5 Vegetables
6 Medicinal and aromatic plants
7 Floriculture
8 Spices and cashewnut
9 Coconut and arecanut

(d) *Soil Science and Water Management*

1 Water management and soil salinity
2 Use of saline water in agriculture
3 Water management in high-rainfall areas and temperate hill zones
4 Investigation on correlation of soil test with crop response
5 Microbial decomposition and recycling of farm and city wastes
6 Improvement of soil physical condition to increase agricultural production in problematic areas
7 Micronutrients of soil and plants
8 Advance centre for research on black cotton soils

(e) *Agronomic Research*

1 All-India co-ordinated agronomic research project

(f) *Agricultural Engineering*

1 Research and development of farm machinery and implements production of prototypes and evaluation
2 Optimization of ground water utilization through wells and pumps
3 Energy requirements in the I.A.D. programmes

4 Post-harvest technology

(g) *Operational Research (including National Demonstration and Integrated Pest-control Projects)*

## B. Animal Sciences and Fisheries

(a) *Animal Sciences*
1 Cattle breeding
2 Buffalo breeding
3 Sheep breeding
4 Poultry breeding
5 Goat breeding
6 Pig breeding
7 Agricultural by-products and industrial waste materials
8 Specialized dairy farming (economics of milk production under intensive dairy farming conditions)
9 Epidemiological studies on foot-and-mouth disease

(b) *Fisheries*
1 Composite culture of Indian and exotic fishes and riverine fish seed production
2 Propagation of air-breathing fishes in swamps
3 Ecology and fisheries of freshwater reservoirs
4 Utilization of fresh fish and transportation of fresh fish
5 Brackish water fish farming

## C. Miscellaneous

1 Agro-industrial complex in Karnataka and Bihar (Indo-Bulgarian Joint Programme sanctioned from cess funds)

## All-India Co-ordinated Research Programmes

1 Biological control of crop pests
2 Nematode pests and their control
3 Rodent control
4 Algae

# APPENDIX 7

## BOOKS AND MONOGRAPHS PUBLISHED BY THE ICAR

1931

1 Butler, E. J. and Bisby, G. R. *Fungi of India*, 137 p. (Sci. Monogr.)

1933

2 Ghosh, C. C. *Silk industry of Japan with notes on observations in USA, England, France and Italy*, 127 p. (Sci. Monogr. 8)

3 McRao, W. and Shaw, F. J. F. *Influence of manures on the wilt diseases of* Cajanus indicus *Spreng and the isolation of types resistant to the disease*, 68 p. (Sci. Monogr. 7)

1935

4 Bhalerao, G. S. *Helminth parasites of the domesticated animals in India*, 265 p. (Sci. Monogr. 6)

5 Blatter, E. J. and Mc Cann, C. *Bombay grasses*, 324 p. (Sci. Monogr. 5)

6 Srivastava, R. C. *Open pan system of white sugar manufacture*, edn 2, 141 p. (Sci. Monogr. 3)

7 Wade, C. P. G. *Mechanical cultivation in India : history of experiments carried out by Burmah Shell Oil Storage and Distributing Co. of India Ltd*, 124 p. (Sci. Monogr. 9)

1936

8 Deshpande, B. P. and Nadkarny, N. T. *Spotted bollworms of cotton* (Earias fabia *Stoll and* Earias insulana *Bosid.*) *in South Gujarat, Bombay Presidency: final report on investigations financed by the Indian Central Cotton Committee*, 1923 *to* 1931, 208 p. (*Sci.* Monogr. 10)

1937

9 Chelva Ayyangar, H. N. *Investigation on the course and distribution of the nerves supplying levator anguli-scapuli and rhomboideus muscles and the formation of the phrenic nerve in the ox with observations in certain anatomical deviations*, 60 p. (Sci. Monogr. 11)

1938

10 Mundkur, B. B. *Fungi of India*, Supplement 1 (Sci. Monogr. 12)

1939

11 Chelva Ayyangar, H. N. *Further observations on anatomical deviations in the ox and notes on certain anatomical freaks*, 49 p., 88 plates (Sci. Monogr. 13) (reduced price)

1940

12 Mehta, K. C. *Further studies in cereal rusts in India*, part 1, 223 p. (Sci. Monogr. 14)

1944

13 Kantikar, N. V. *Dry farming in India*, 317 p. (Sci. Monogr. 15)

1945

14 Pruthi, H. S. and Mani, M. S. *Our knowledge of the insect and mite pests of citrus in India and their control*, 42 p., 6 plates (Sci. Monogr. 16)

1949

15 Chopra, R. N., Badhwar, R. L. and Ghosh, S. *Poisonous plants of India*, Vol. 1, 762 p. (Sci. Monogr. 17)

16 Shaw, F. J. F. *Handbook of statistics for use in plant breeding and agricultural problems*

1951

17 Randhawa, M. S. *Developing village India : studies in village problems*, 290 p. (Orient Longman, issued under the authority of the ICAR)

18 Warner, J. N. *Dairying in India*, 380 p. (Animal Husbandry manual)

1953

19 Ramiah, K. *Rice breeding and genetics*, 360 p. (Sci. Monogr. 19)

20 Sen, K. C. *Animal nutrition research in India*, 370 p. (Animal Husbandry manual), Macmillan & Co.

1954

21 Cheema, G. S., Bhat, S. S. and Naik, K. C. *Commerical fruits of India with special reference to western India*, 422 p. Macmillan & Co.

1955

22 *Directory of the Agricultural and animal husbandry research stations in India*, 235 p.

1956

23 Bhattacharya, S. C. and Dutta, S. *Classification of citrus fruit of Assam*, 110 p. (Sci. Monogr. 20)

24 Ghose, R. L. M, Ghatge, M. B. and Subrahmanyam, V. *Rice in India*, 567 p. (rev. in 1960), 474 p.

1957

25 Gadkary, D. A. *Mechanical cultivation in India*, 147 p.

26 Gangoly, S. R., Ranjit Singh, Katyal, S. L. and Daljit Singh. *Mango*, 530 p.

27 Randhawa, M. S. *Flowering trees of India*, 210 p.

28 Whyte, R. O. *Grassland and fodder resources of India*, 437 p. (Sci. Monogr. 22)

1958

29 Randhawa, M. S. *Agricultural research in India : institutes and organisations*, 448 p.

30 Randhawa, M. S. *Agriculture and animal husbandry in India*, 364 p.

31 Subbiah Pillai, M. *Cultural trials and practices of rice in India*, 166 p. (Sci Monogr. 27)

1959

32 Baini Prashad and Sen-Sharma, P. K. *Revision of termite genus* Nasutitermes *Banks (Isoptera, Termitidae, Nasutitermitinae), from the Indian region*, 66 p. (Monogr. 23)

33 Dastur, R. H. *Physiological studies on the cotton crops and their practical applications*, 1968, 133 p. (first published by Indian Central Cotton Committee, Bombay, 1959, and reprinted by ICAR in 1968)

34 Desikachary, T. V. *Cyanophyta*, 686 p. (Monogr. on Algae 2)

35 Devadas, R. P. *Textbook of home science*, 320 p.

36 Naidu, P. M. N. *Poultry keeping in India*, 1959, 293 p., reprinted in 1964

37 Randhawa, M. S. *Zygnemaceae*, 478 p. (Monogr. on Algae)

38 Randhawa, M. S. and Prem Nath. *Farmers of India*, Vol. I. *Pun-*

*jab, Himachal Pradesh and Jammu and Kashmir*, 302 p.

39 Sen, S. K. *Chemotherapy of animal trypanosomiasis* (a resume of literature), 210 p. (Sci. Monogr. 22)

40 Sharma, Y. M. L. *Lessons in forestry*, 186 p.

1960

41 Baini Prashad and Sen-Sharma, P.K. *Revision of the termite genus* Hospitalitermes *Holmgren (Isoptera, Termitidae, Nasutitermitinae) from the Indian region*, 32 p. (Monogr. 29)

42 Butler, E. J. and Bisby, G. R. *Fungi of India*, revised by R. S. Vasudeva, 552 p.

43 *Directory of research workers of agricultural and animal husbandry in India*, 1959-60, 108 p.

44 Ghose, R. L. M., Ghatge, M. B. and Subrahmanyam, V. *Rice in India*, revised in 1960, xii + 474 p.

45 Girdhari Lal, Siddappa, G. S. and Tandon, G. L. *Preservation of fruits and vegetables*, 358 p.

46 *Indigenous agricultural implements of India : all India survey*, 401 p.

47 Jenney, H. and Raychaudhuri, S. P. *Effects of climate and cultivation on nitrogen and organic matter reserves in Indian soils*, 126 p.

48 Kantikar, N. V. *Dry farming in India*, edn 2 (with a supplement by S. S. Sirur and D. H. Gokhale), 410 p.

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**Abbreviations used in the Index**

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|---|---|
| AAU | Assam Agricultural University, Assam |
| AICRIP | All-India Co-ordinated Rice Improvement Project |
| AICRP | All-India Co-ordinated Research Project |
| APAU | Andhra Pradesh Agricultural University, Hyderabad, Andhra Pradesh |
| ASRB | Agricultural Scientists' Recruitment Board, New Delhi |
| BCKVV | Bidhan Chandra Krishi Vishwa Vidyalaya, Haringhatta, West Bengal |
| CARI | Central Agricultural Research Institute, Andaman and Nicobar Group of Islands, Port Blair |
| CAU | College of Agriculture, Udaipur, Rajasthan |
| CAZRI | Central Arid Zone Research Institute, Jodhpur, Rajasthan |
| CSAUAT | Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh |
| CIAE | Central Institute of Agricultural Engineering, Bhopal, Madhya Pradesh |
| CICR | Central Institute for Cotton Research, Nagpur, Maharashtra |
| CIFRI | Central Inland Fisheries Research Institute, Barrackpore, West Bengal |
| CIFT | Central Institute of Fisheries Technology, Cochin, Kerala |
| CMFRI | Central Marine Fisheries Research Institute, Cochin, Kerala |
| CMRS | Central Mango Research Station, Lucknow, Uttar Pradesh |
| CPCRI | Central Plantation Crops Research Institute, Kasaragod, Kerala |
| CPRI | Central Potato Research Institute, Simla, Himachal Pradesh |
| CRRI | Central Rice Research Institute, Cuttack, Orissa |
| CSCA | Central Staff College of Agriculture, Hyderabad, Andhra Pradesh (*see also* NAARM) |
| CSSRI | Central Soil Salinity Research Institute, Karnal, Haryana |
| CSWCRTI | Central Soil and Water Conservation Research and Training Institute, Dehra Dun, Uttar Pradesh |
| CSWRI | Central Sheep and Wool Research Institute, Malpura, Rajasthan |
| CTCRI | Central Tuber Crops Research Institute, Trivandrum, Kerala |
| CTRI | Central Tobacco Research Institute, Rajahmundry, Andhra Pradesh |
| CTRL | Cotton Technological Research Laboratory, Bombay, Maharashtra |

| | |
|---|---|
| GAU | Gujarat Agricultural University, Dantiwada, Gujarat |
| GBPUAT | Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttar Pradesh |
| HAU | Haryana Agricultural University, Hissar, Haryana |
| HPKVV | Himachal Pradesh Krishi Vishwa Vidyalaya, Palampur, Himachal Pradesh |
| IARI | Indian Agricultural Reserch, Institute, New Delhi |
| IASRI | Indian Agricultural Statistics Research Institute, New Delhi |
| ICAR | Imperial Council of Agricultural Research / Indian Council of Agritural Research |
| ICAR-RCNEHR | ICAR Research Complex for North-Eastern Hills Region |
| IDRC | International Development Research Centre, Canada |
| IGFRI | Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh |
| IIHR | Indian Institute of Horticultural Research, Bangalore, Karnataka |
| IISR | Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh |
| ILRI | Indian Lac Research Institute, Namkum, Ranchi, Bihar |
| IVRI | Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh |
| JARI | Jute Agricultural Research Institute, Barrackpore, West Bengal |
| JNKVV | Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh |
| JTRL | Jute Technological Research Laboratory, Calcutta, West Bengal |
| KAU | Kerala Agricultural University, Mannuthy, Kerala |
| KKV | Konkan Krishi Vidyapeeth, Dapoli, Maharashtra |
| MAU | Marathwada Agricultural University Parbhani, Maharashtra |
| MPKV | Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra |
| NAARM | National Academy of Agricultural Research Management, Hyderabad, Andhra Pradesh |
| NBPGR | National Bureau of Plant Genetic Resources, New Delhi |
| NBSSLUP | National Bureau of Soil Survey and Land Use Planning, Nagpur, Maharashtra |
| NDRI | National Dairy Research Institute, Karnal, Haryana |
| NDUAT | Narendra Dev University of Agriculture and Technology, Faizabad, Uttar Pradesh |
| OUAT | Orissa University of Agriculture and Technology, Bhubaneshwar, Orissa |
| PAU | Punjab Agricultural University, Ludhiana, Punjab |
| PIRRCOM | Project for Intensification of Regional Research on Cotton, Oilseeds and Millets |
| PKV | Punjabrao Krishi Vidyapeeth, Akola, Maharashtra |
| RAU | Rajendra Agricultural University, Patna, Bihar |
| SBI | Sugarcane Breeding Institute, Coimbatore, Tamil Nadu |
| SWCRDT | Soil and Water Conservation Research Demonstration and Training Centre |
| TNAU | Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu |
| UAS | University of Agricultural Sciences, Bangalore, Karnataka |

| | |
|---|---|
| UU | University of Udaipur, Udaipur, Rajasthan |
| VPKAS | Vivekananda Parvatiya Krishi Anusandhan Shala, Almora, Uttar Pradesh |